MODERN PLASTICS

September 1956

page 45 **The Plastiscope, Section 1 . . . vital news of the industry**

page 97 **How you can use the new decorated impact styrene sheets**

AN IMPROVED ARC-RESISTANT PHENOLIC IN FREE-FLOWING NODULAR FORM

Durez 18001 black nodular molding compound brings to design engineers, molders, manufacturers, and consumers an improved arc-resistant material designed for easy preforming and use in automatic molding machines.

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MODERN PLASTICS*

Volume 34
September 1956
Number 1

Modern Plastics Executive and Editorial Offices 575 Madison Avenue, New York 22, N.Y.

Modern Plastics published monthly by Breskin Publications, Inc., at Emmett St., Bristol, Conn. Modern Plastics Encyclopedia Issue published as second issue in September by Plastics Catalogue Corp., at Emmett St., Bristol, Conn. Second-class mail privileges authorized at Bristol, Conn. Subscription rates (including Modern Plastics Encyclopedia Issue, which is not sold separately), payable in U.S. currency: In United States, its possessions, and Canada, 1 year $7, 2 years $12, 3 years $17; Pan-American countries, 1 year $10, 2 years $17, 3 years $24; all other countries, 1 year $20, 2 years $35, 3 years $50. Single copies 75¢ each (Show issue, $1.00) in the U.S. its possessions, and Canada; all other countries $2.00 (Show issue $2.50). *Reg. U.S. Pat. Off.

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Editorial

Problem of distribution

It must be obvious to even the most disinterested observers that the next big market to be opened to plastics will be in the building and construction field.

In that field, particularly in small-home construction, prefabrication lends itself to the use of plastics. Towards that field the whole plastics industry is aiming a barrage of code and standards committee work, of architectural competitions, of university seminars, of publicity—even of experimental all-plastics buildings. Size of the market well justifies the effort.

To date, plastics have succeeded in the building field in the form of high-pressure laminates, vinyl floorings, styrene wall tiles, luminous ceilings, and polyester-fibrous glass translucent panels. They have scarcely been tried in load-bearing applications. Yet in those uses, where prebuilt insulation, integral finish, prefab processing, and ease of assembly in the field are important, lies the future of plastics in building.

Admittedly the revision of codes to embrace plastics is a big job which must be done. Likewise the training of traditional construction skills to the use of plastics. Likewise the gaining of approval by architects. Likewise the encouragement of consumer interest.

But a bigger problem than all of these is the problem of distribution.

If, today, plastics were already written into the building codes, approved by architects, accepted by the public and presented no problems to the building crafts, where could a home builder buy them in small lots, with specified qualities, cut to size and near to the job? Could he get a selection of rigid vinyl, polyethylene, and styrene copolymer sheets with welding rods and heat-guns from a sheet metal supply house, a lumberyard, or a plastics source nearby? Could he get a variety of plastics pipes and fittings from even his plumbing distributor? Could he even handily procure polyethylene film for barrier use? He could not!

This problem of distribution of plastics to the vast building field is a challenge to the industry, a mighty opportunity for the distributors of traditional building materials—and an opportunity also for expansion by the few horizontally organized distributors of plastics sheet and tube materials.

There'll be even bigger opportunities ahead in the distribution of composite structural (sandwich) materials.

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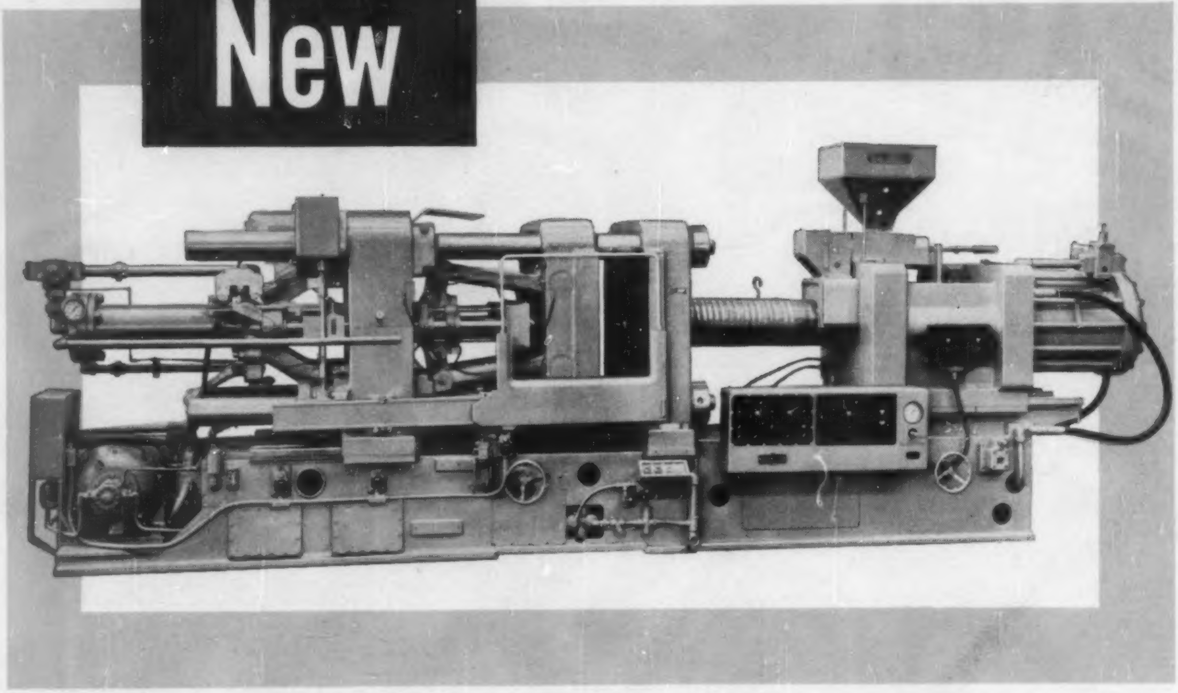

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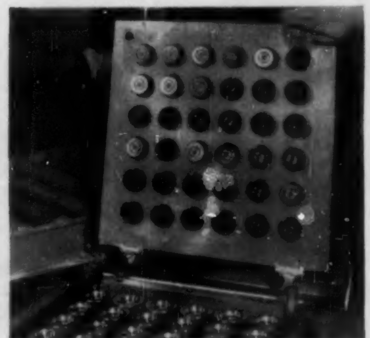

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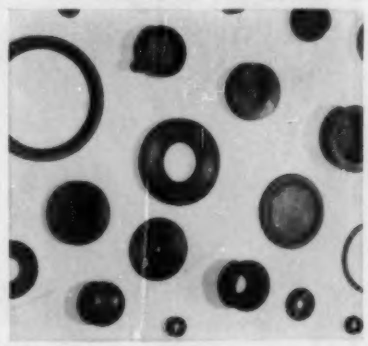

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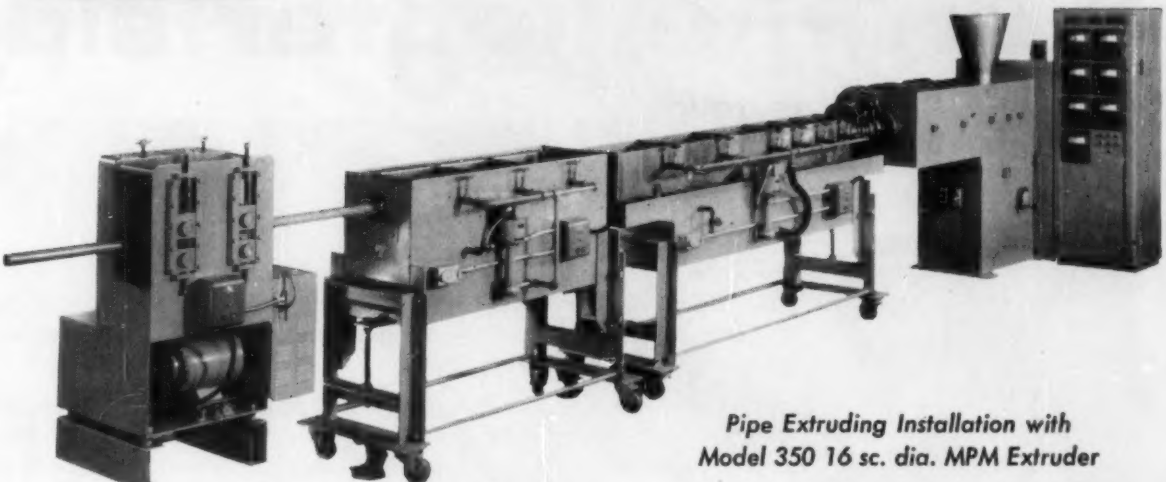

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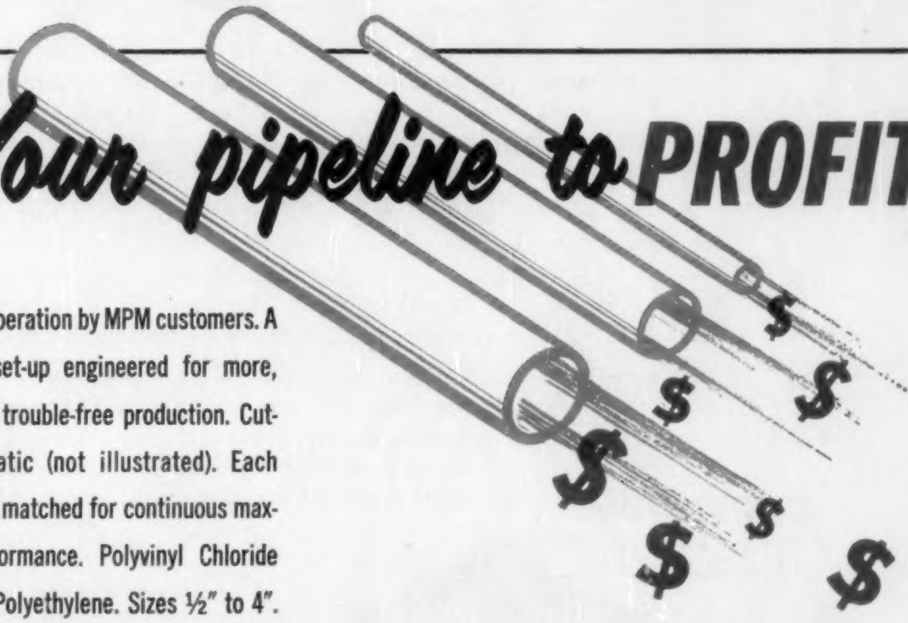

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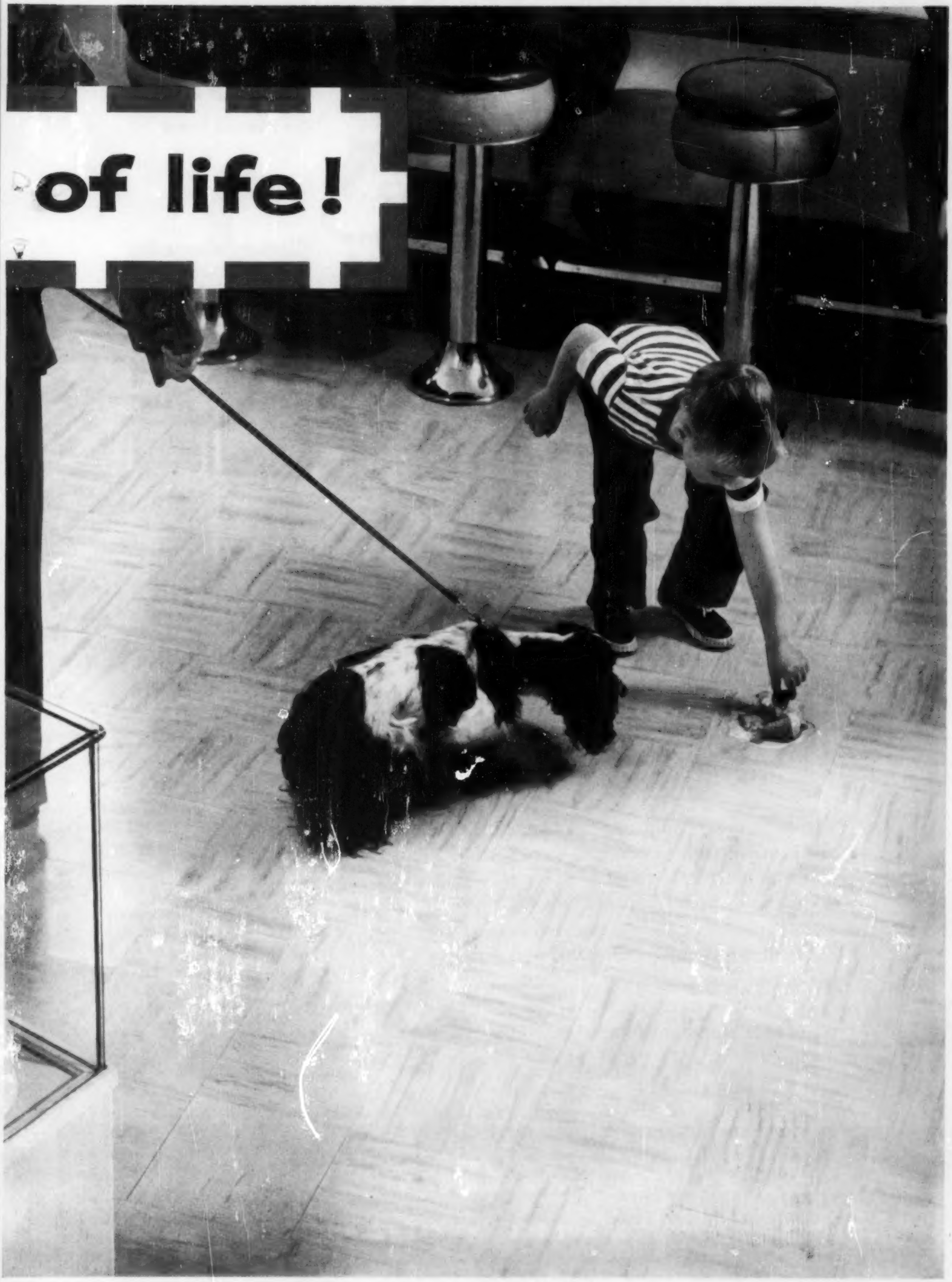
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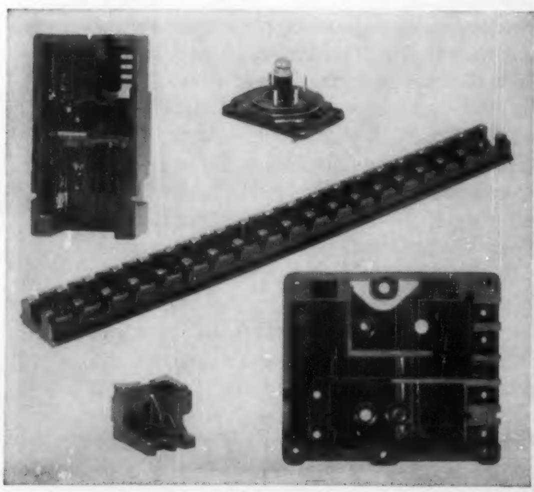

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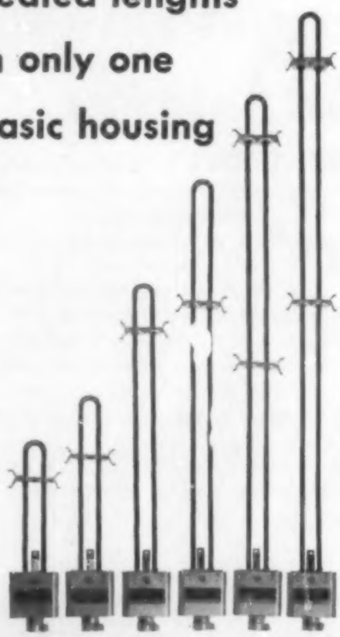

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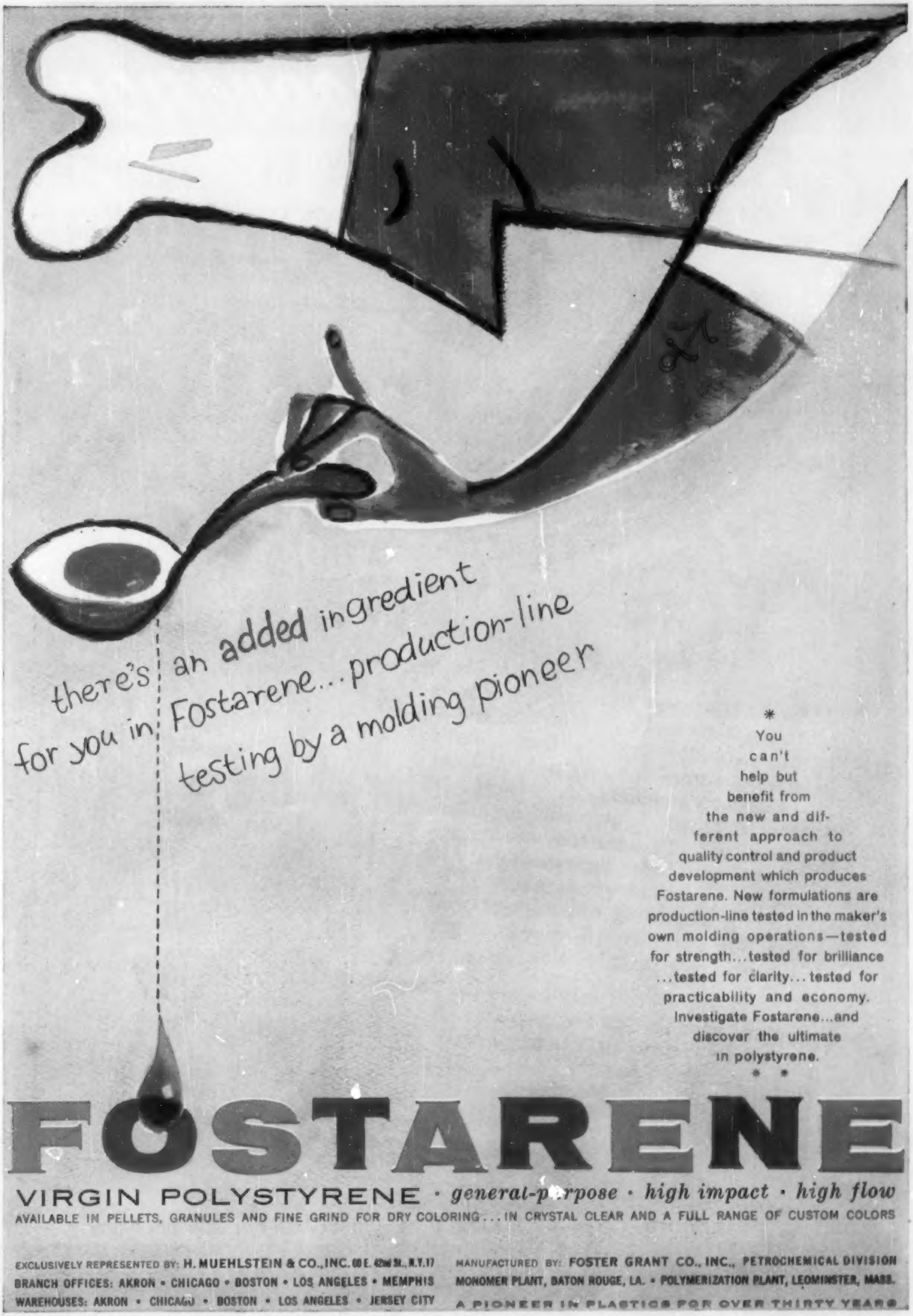
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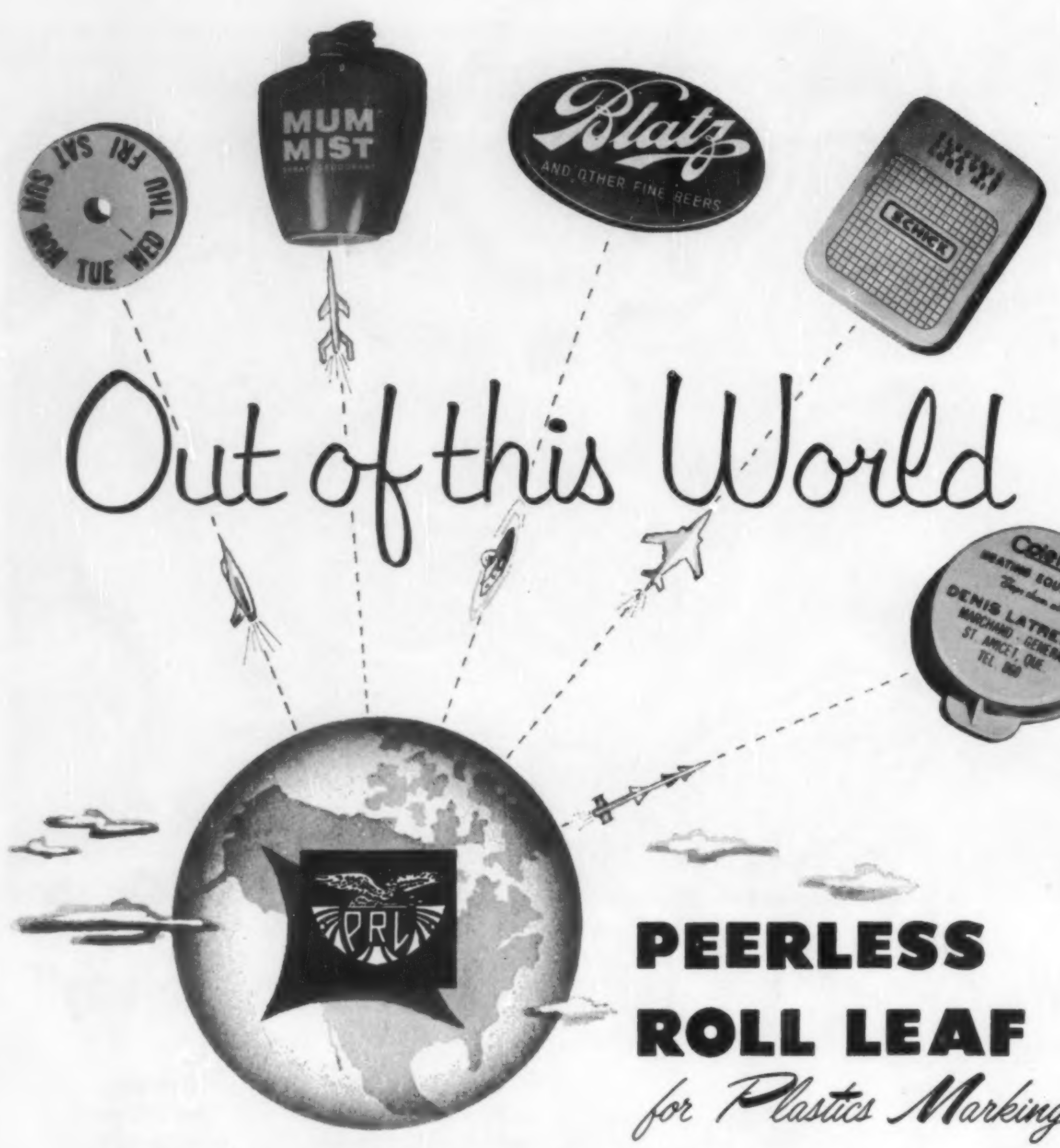

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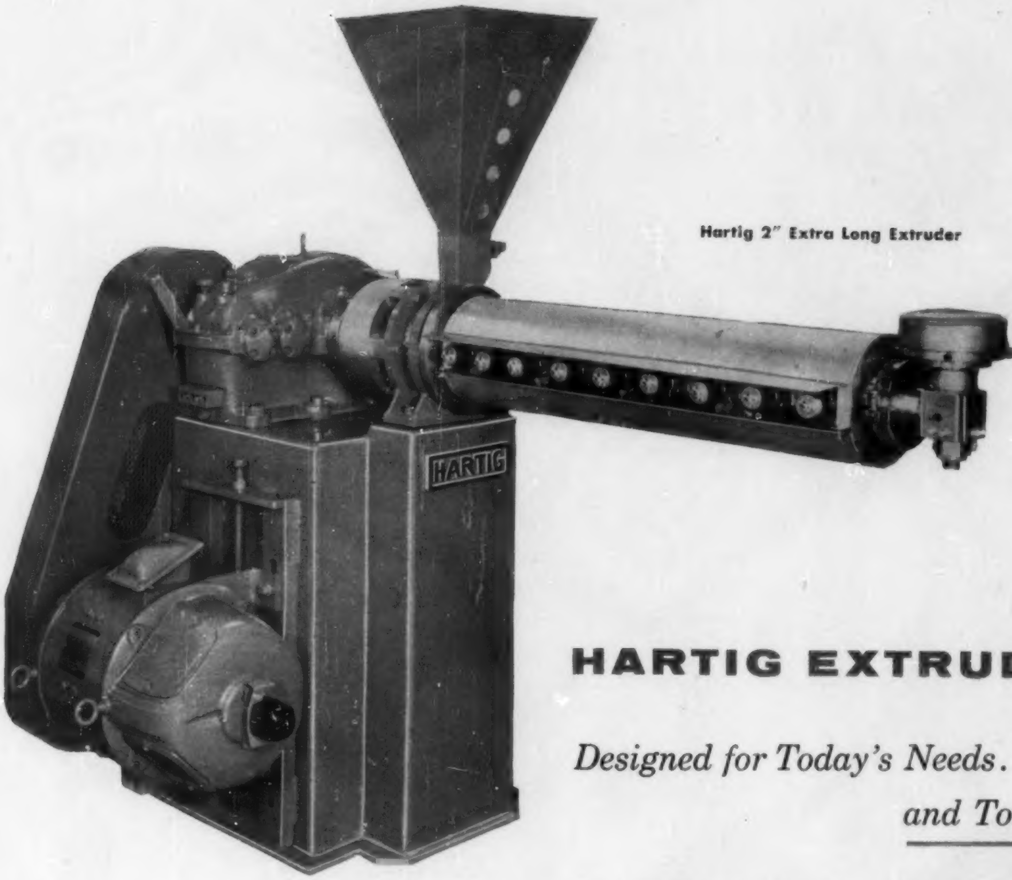

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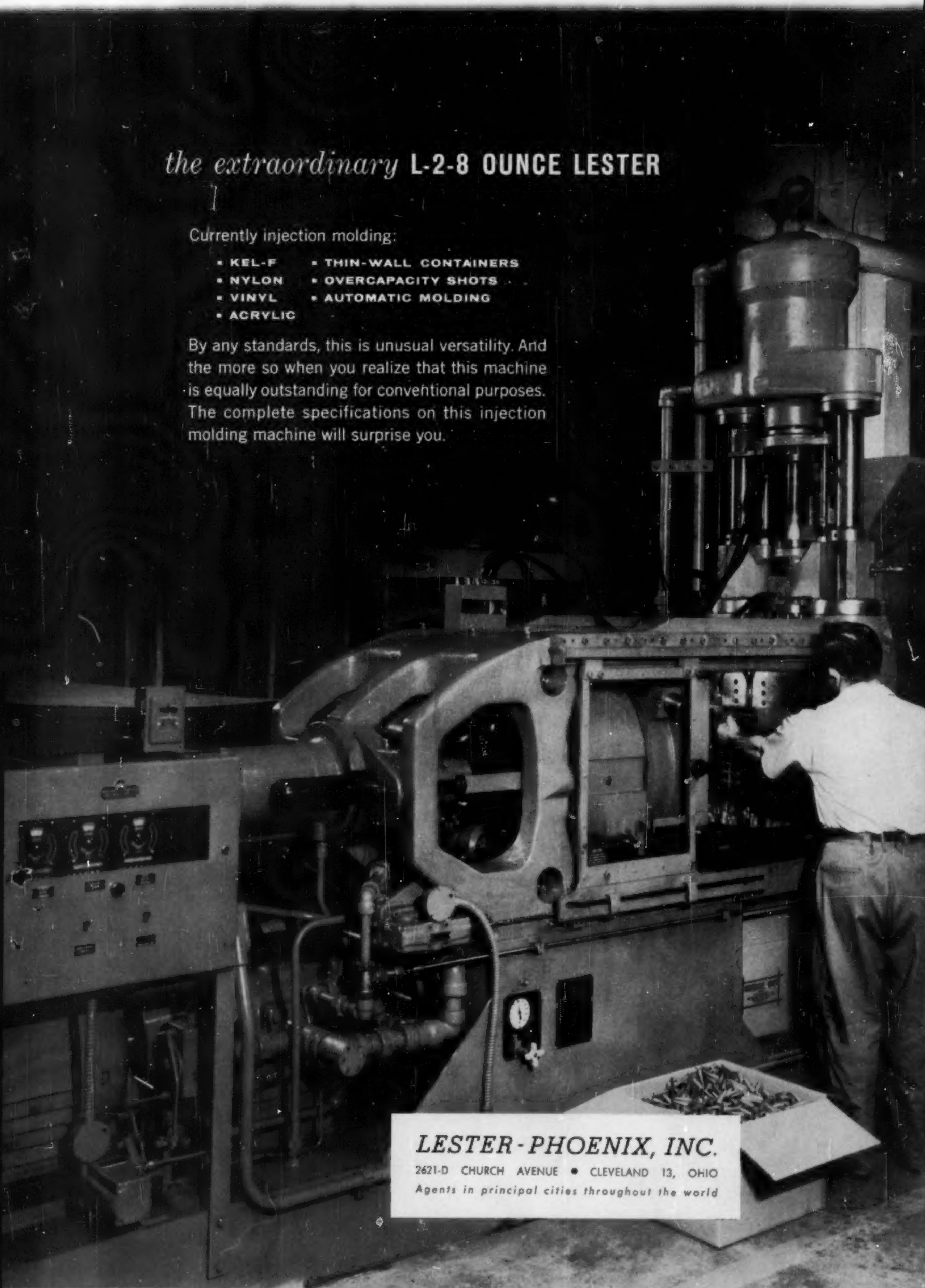
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Break (p.s.i.)	D638-52T	3470—5240
Elongation (%)	D638-52T	56—66
Flexural properties:		
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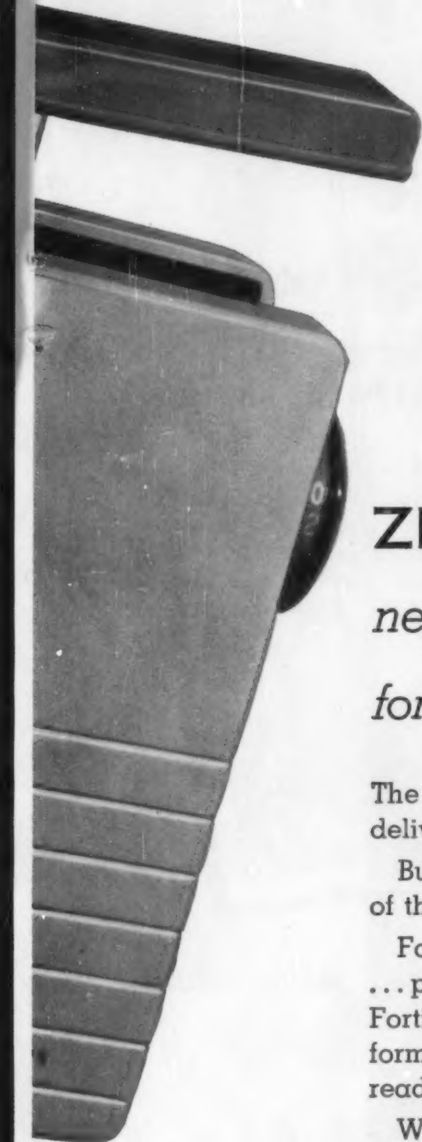
Flexural modulus (10^6 p.s.i.)	D790-49T	0.23—0.30
Rockwell hardness:		
(R scale)	D785-51	62—94
Izod impact:		
(ft. lb./in. notch)	D256-43T	2.7—11.0
Heat distortion:		
(°C.)	D648-45T	59—70
Water absorption:		
% sol. lost	D570-42	0.00—0.08
% moisture gain	D570-42	1.5—1.8
% water absorption	D570-42	1.6—1.8



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decrease your cost?
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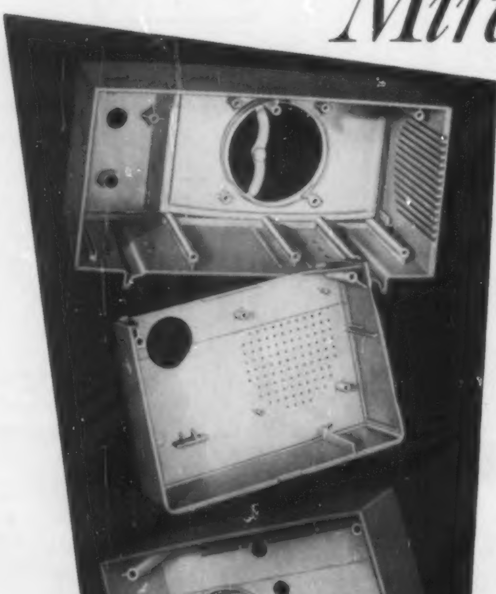

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Incredibly complex machines . . . over 10 acres of electronic "day-after-tomorrow" manufacturing equipment . . . a production line over a mile long . . . combine to produce PRECISION-EERED television and radios like the models shown above! The last word in quality!

Bridgeport does their part — on advanced machinery and with modern production methods— to mold some of the intricate, durable plastic cabinets that play a role in Westinghouse performance. Not a step has been spared to make Westinghouse quality supreme in the industry.

Perhaps Bridgeport can help you produce superior products, too.

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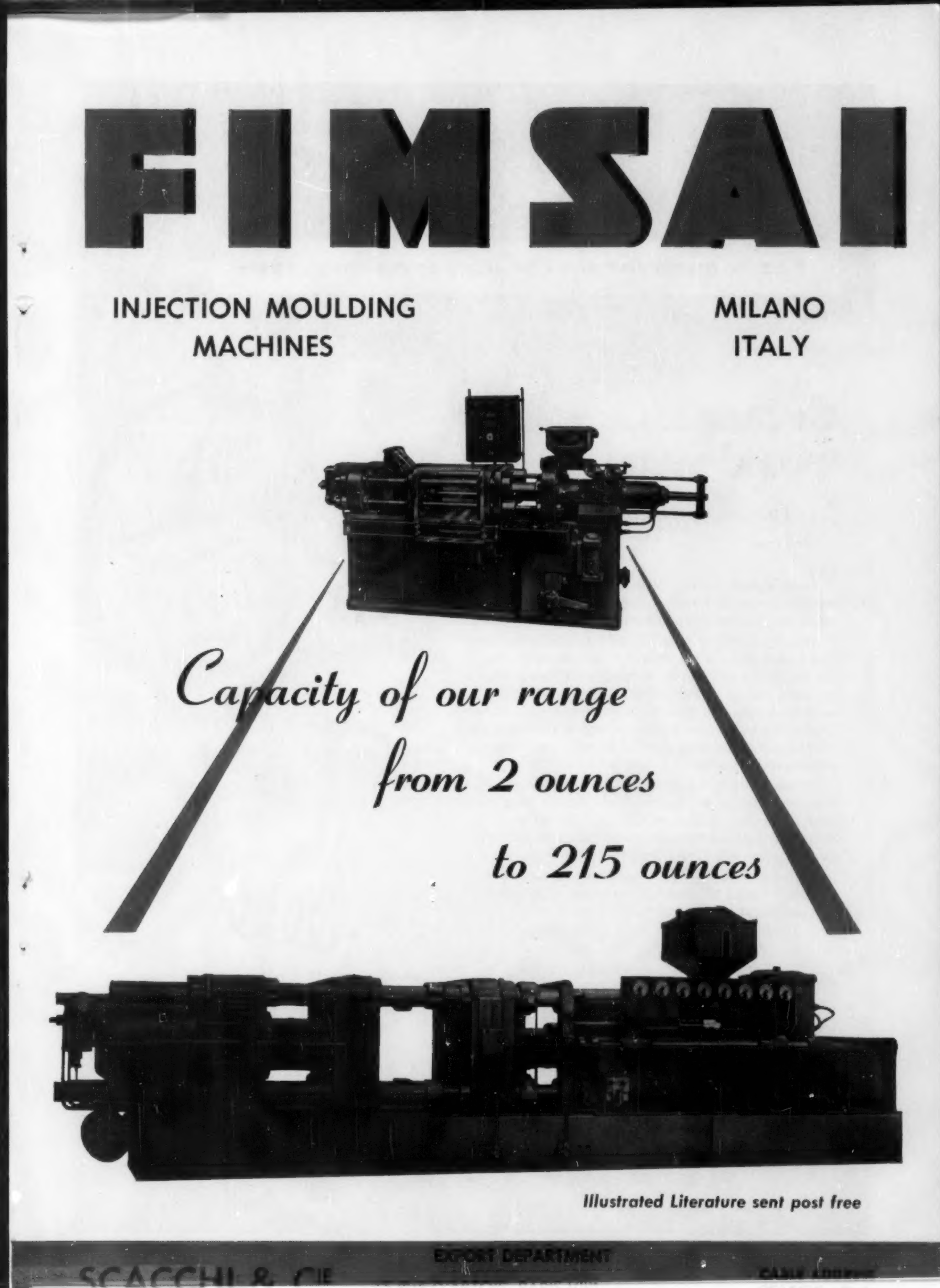
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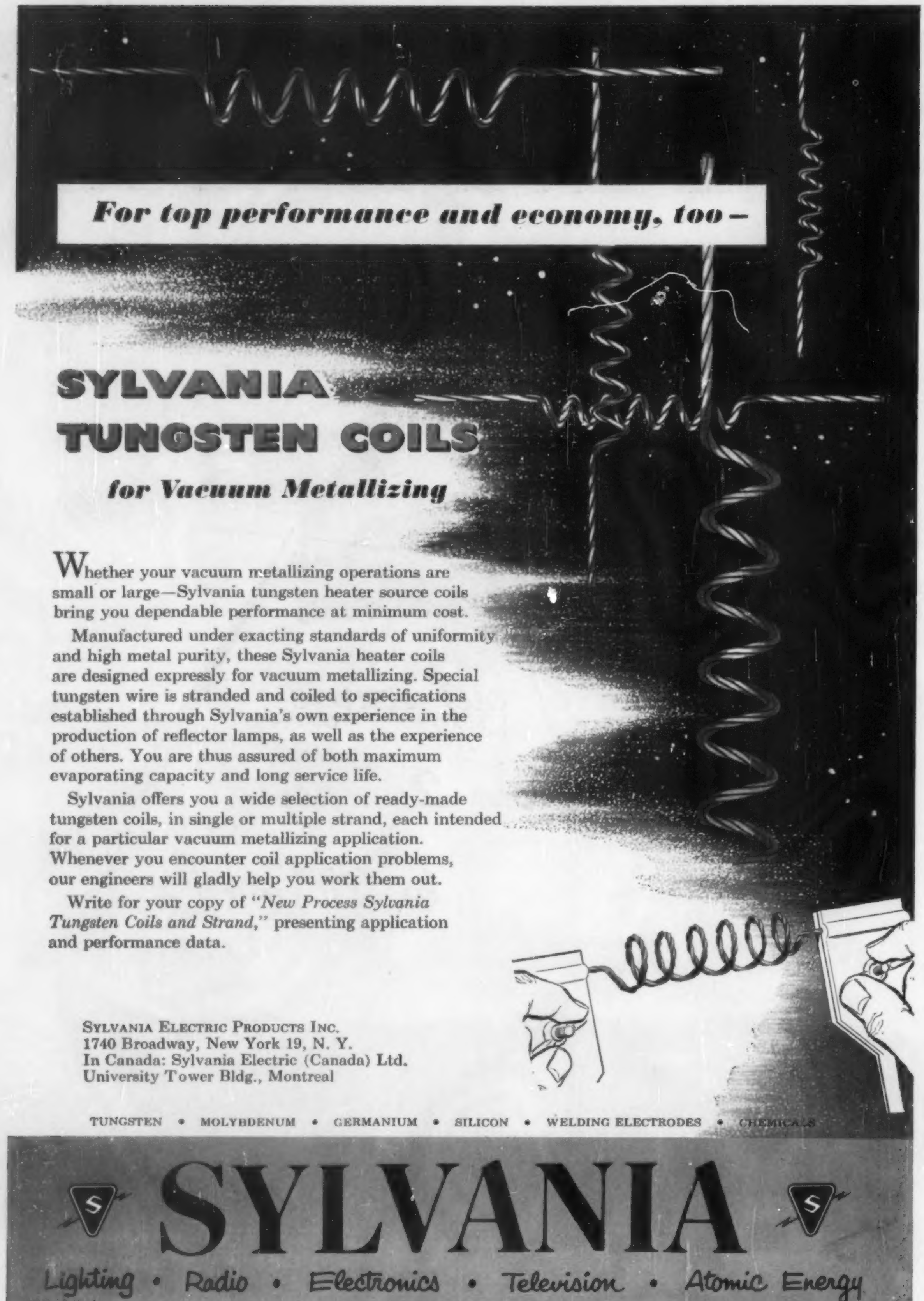

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SYLVANIA TUNGSTEN COILS
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Whether your vacuum metallizing operations are small or large—Sylvania tungsten heater source coils bring you dependable performance at minimum cost.
Manufactured under exacting standards of uniformity and high metal purity, these Sylvania heater coils are designed expressly for vacuum metallizing. Special tungsten wire is stranded and coiled to specifications established through Sylvania's own experience in the production of reflector lamps, as well as the experience of others. You are thus assured of both maximum evaporating capacity and long service life.
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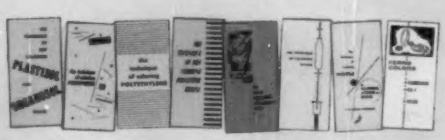
for all plastic materials!



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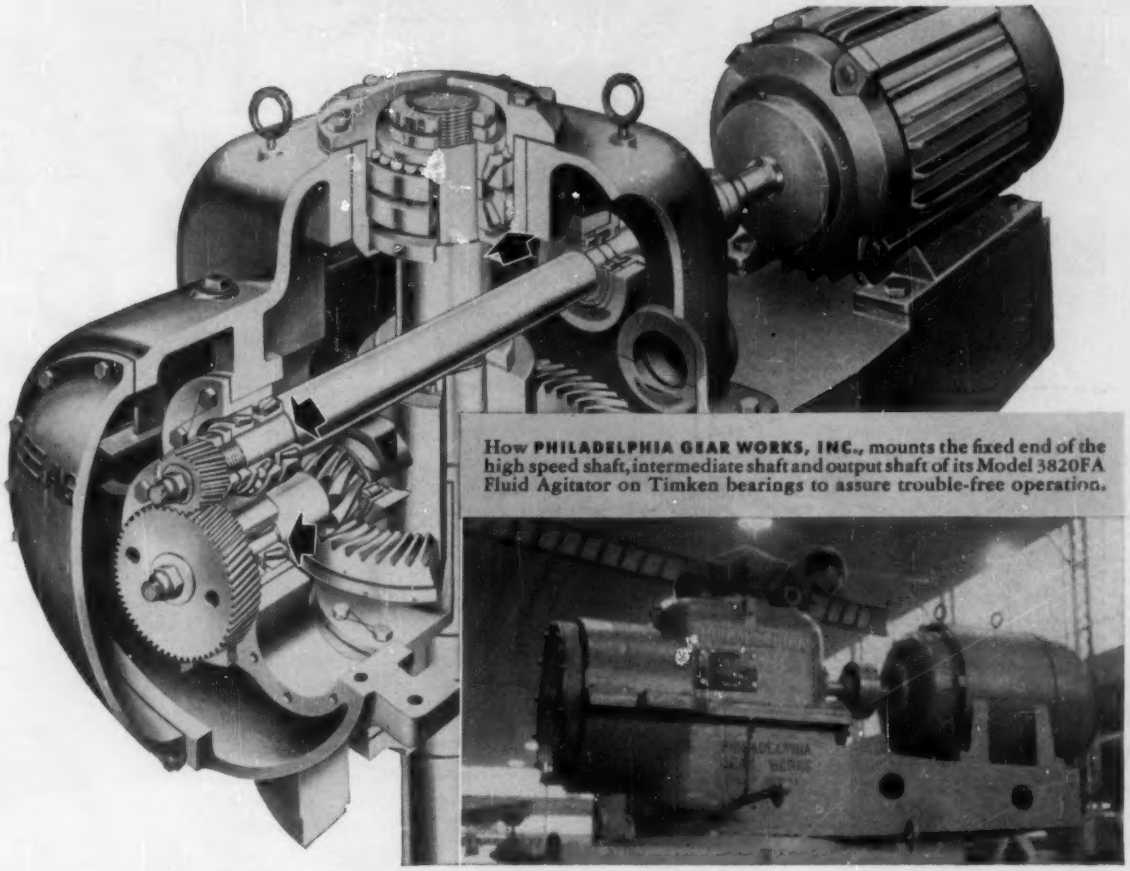
How TIMKEN® bearings keep shafts aligned —fluid agitator running trouble-free



How **PHILADELPHIA GEAR WORKS, INC.,** mounts the fixed end of the high speed shaft, intermediate shaft and output shaft of its Model 3820FA Fluid Agitator on Timken bearings to assure trouble-free operation.

ONE of the "musts" in designing this new line of Philadelphia Agitator Drives was precise shaft alignment and position–vital to assure trouble-free driving of a mixer. That's why Philadelphia Gear Works engineers mount the fixed end of the high speed shaft, intermediate shaft and output shaft on Timken® tapered roller bearings. They positively hold shafts in position and in precise, rigid alignment. They help the agitator operate dependably, with maximum efficiency. They protect against costly shutdowns.

Timken bearings' tapered construction lets them take both radial and thrust loads in any combination. And they give you extra load-carrying capacity, because of full line contact between rollers and races. Gears mesh more smoothly, more accurately. Shaft wear is eliminated. Gear wear is reduced.

And Timken bearings practically eliminate friction. They're geometrically designed to roll true, made microscopically accurate to live up to their design.

To further insure bearing quality, we even make our own steel. We're America's only bearing manufacturer that does.

Only Timken bearings offer you so many advantages. That's why it pays you to specify them for the machines you buy or build. Look for the trade-mark "TIMKEN" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN *TAPERED ROLLER BEARINGS ROLL THE LOAD*

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The Plastiscope* September 1956

News and interpretations of the news

By R. L. Van Boskirk

Section 1

West Coast plastics show. Starting March 18, 1957, a four-day West Coast Plastics Show will be held in the Shriner's Auditorium, Los Angeles; the sessions and headquarters will be at the Biltmore in the same city. The show will be under the approval of the National S.P.I. and under the supervision of the West Coast Division of S.P.I.

Stereospecific plastics. Only a few plastics processors have ever heard this tongue twister, but in a few years they will be as familiar with it as they are now with methyl methacrylate and other complex tongue twisters in plastics terminology. The significance behind this new word is far greater than the development of a plastics polymer or catalyst—it marks the beginning of a new method or system for producing polymers. A prominent research director describes the developments associated with stereospecific polymers and low-pressure, organochemical catalysts as perhaps the most significant development in plastics since the discovery of phenolic molding material.

The word stereospecific received widespread publicity when Prof. Natta, consultant to Montecatini of Italy, delivered two lectures in this country at the Gordon Research Conference and the recent polymer symposium sponsored by Grace Research and Development Co. at Notre Dame University under the direction of Dr. Frank D'Alelio. Such high polymer experts as Dr. Herman Mark of Brooklyn Polytech, Dr. A. P. Lien of Standard Oil of Indiana, Dr. W. B. Reynolds of Phillips Petroleum Co., also delivered papers at that symposium. The present surge of interest in the possibilities of stereospecific plastics has grown from Montecatini's announcement that they were ready to produce polypropylene with isotactic polymers and there is also evidence that Ziegler, Phillips, and Standard of Indiana are moving along similar lines.

Definitions. The dictionary defines stereochemistry as having to do with the arrangement of atoms and molecules in space. Specificity is defined as that state or quality of being specific. Hence, a home-made definition of stereospecific could be "the arrangement of molecules in a specified form." Dr. D'Alelio likes to describe it as the arrangement of polymers in a predetermined geometric form rather than in random fashion. Nature itself has shown this specificity in biological synthesis and in silk, cotton, wool, flax, hair, and many others.

The new organo-chemical catalysts like those used in low-pressure polyethylene processing are tools in this new chemistry. They may be alumi-

* Reg. U. S. Pat. Off.

num alkyls, titanium tetrachloride, and many other metal derivatives. The reaction is a surface action or a heterogeneous system—that is, no force is required to bring about polymerization. Heretofore, polymerization has been in a homogeneous system whereby the catalyst is "mixed" with the chemical and pressure must be used to force polymerization.

Advantages of specificity. The big advantage of specificity is that it permits plastics to be tailored to meet given specifications. Some day it may make plastics competitive with many building materials. Who knows but that some day it may result in thermoplastics with some of the properties of thermosets? Synthetic natural rubber is already produced by Ziegler-type systems and even with lithium, which is not a Ziegler system. Seven other types of rubber can be made by this system of polymerizing isoprene. So far only the polyolefins can be thus polymerized, but the day will come when other catalysts and perhaps an ion exchange system will be developed that will broaden the base. The industry now has a new chemical tree and is stepping up to a new plateau that applies especially to plastics. There is also a possibility that stereospecific chemistry may lead to the future production of synthetic polypeptides that can be used as curative protein foods or structures for reconstruction of damaged or diseased living tissues.

How soon and how much? Plastics users are warned not to expect any substantial production of these new plastics for several years to come. Even polypropylene, now in pilot-plant production in Italy and well along the laboratory road toward production in the U. S. too, is probably at least 1½ years away from substantial production.

A long time would be required to bring commercial plants into production that can make practical use of the new stereospecific methodology even if it were fully developed. And, again quoting Dr. D'Alelio, this system is in its early stages—fundamentals must be better established. The researchers are not yet concerned with final end products such as tires or gloves. They must first learn the basic problems involved in production processes. Millions of dollars and thousands of man-hours of work are going to have to be invested in basic research on this most promising project before it will attain full fruition.

Another high-density, high-pressure polyethylene. Spencer Chemical Co., after only a year and a half in the polyethylene business, has just come up with the highest density (0.940) high-pressure polyethylene yet announced in the U. S. As reported on page 234 of the August Modern Plastics, these higher density high-pressure polyethylenes fit in between the older high-pressure and the new low-pressure polyethylenes. Density of the older polyethylenes is in a range of from about 0.910 to 0.920. The intermediate densities range from about 0.920 to 0.940 at present, although there is as yet no agreement as to exactly where the intermediate-density figure should start or end. Density of low-pressure material is around 0.960.

There will be many more of these so-called intermediate density polyethylenes announced in the near future. Du Pont has publicized a 0.930 material and is thought to have an even higher density type ready for market; Bakelite has one of 0.923; I.C.I. of England has a 0.940 product. Spencer's new 0.940 density material will be known as Poly-Eth Hi-D. Important to the future of polyethylene is the fact that these new intermediate-density

materials are the result of processing innovations and not of rebuilding or revising high-pressure equipment already in operation.

It should be further noted that Spencer is also going ahead with plans for a pilot plant to produce low-pressure polyethylene under a license recently granted them by Standard Oil of Indiana. And amidst the enthusiasm created by Spencer's newest achievements, sight should not be lost of its new conventional-type resin TD 117, one of its 1400 series resins for molding. There is also a new film grade resin in its 2400 series. These two new 0.925 density Poly-Eth resins are only two months old but have already had good acceptance.

Properties of the new high-pressure polyethylenes. The new Spencer Hi-D series of polyethylenes has several properties that are different from the older polyethylenes. It has higher heat resistance, improved stiffness or rigidity that improves dimensional stability and sometimes permits reduction in wall thickness, better impermeability, higher gloss, improved resistance to surface abrasion, and faster molding cycles. The latter feature is the result of the fact that pieces molded of higher density material can be taken from the mold more quickly. Film grade resin of this new intermediate-density material is not yet on the market but is expected to be available later.

Spencer tests indicate that when subjected to dry heat of 240° F. for 20 min. (oven test), pieces molded of polyethylene with a density of 0.920 or below will collapse; those molded of 0.935 to 0.940 material shrink a bit, but the material will withstand higher than boiling temperature and still retain its properties. Prospective users of the higher density polyethylenes should also note that danger of stress cracking is increased as density goes up and take steps to avoid serious problems arising from this tendency.

Polyethylene for extrusion-vacuum forming. Bakelite Co. has brought out a new polyethylene resin designed for making sheet to be used for extruder-vacuum forming. As DFD 4030, the new resin is available in natural colors; as DFD 4400, it is supplied in colors that are particularly popular in housewares.

In addition to producing a resin with better extrudability, the Bakelite laboratories have developed new experimental equipment and techniques to use with the new sheet. The length of time required in the heating and cooling cycle has been reduced and the critical nature of the take-off between the extruder and the forming machine has been eased.

The new sheet and equipment also permits a deeper draw than formerly. Pans have been formed with a draw of 6 to 7 inches. Bakelite is not producing the equipment for either extrusion or vacuum forming but will pass along its accumulated know-how.

An advantage of extruded-vacuum formed polyethylene is that a high-flow material is not required. The melt index of DFD is very low—in the range of 1 to 2—compared to the high melt index of from 15 to 20 sometimes needed for large molded pieces. Problems of skinning or delamination as well as stress cracking are lessened. Density of the DFD resin is 0.920. The range of sheet thicknesses thus far produced is from 0.040 to 0.120 inches.

A first in low-pressure polyethylene products. Apparently the Campco Div. of Chicago Molded Products has stolen a march on all competitors by becoming the first to announce production of a low-pressure polyethylene product.

The product is an extruded sheet said to be "readily vacuum formed" and available in the same sizes as the company's standard modified

styrene sheets. Furthermore, it is apparently available in both Ziegler and Phillips types which will indeed come as a surprise to the trade. Campco lists sp. gr. as 0.945 for Ziegler and 0.96 for Phillips, and heat distortion points at 66 p.s.i. of, respectively, 140 and 168° F. The company warns that, in vacuum forming, some modification in present heating equipment may be necessary to accommodate the materials' different heating and cooling cycles and the tendency toward plastic memory.

More methyl methacrylate. The growing market for methyl methacrylate looks so promising that Hercules Powder Co. and Imperial Chemical Industries, Ltd. (of England) have formed a new company to produce 35 million lb. a year at the Hercules plant site in Louisiana, Mo. Current plans call for the production of both monomer and polymer.

Together with the recently announced Du Pont expansion, total capacity in the U. S. will now approximate or exceed the estimated 125 million-lb. consumption for methacrylate in 1960 that was forecast in the June 1956 MODERN PLASTICS. I.C.I. was a pioneer of the process which was originally developed for synthesis of methacrylate monomer and will bring to the newly founded company its production, research, and technical sales service experience and know-how.

Hercules will have available ammonia and methanol, used in production of methacrylate, from its plant on the same site and natural gas is available from an adjacent pipeline. A fourth necessary raw material, acetone, is produced by Hercules at Gibbstown, N. J. The new company will produce polymer for plastics for injection and extrusion applications and in monomer form for protective coatings. The latter are now moving strongly into the emulsion paint field and have recently created a considerable stir as automotive lacquers, where they are competitive with nitrocellulose—also a Hercules product. Monomer also has definite growth possibilities for use with fibrous glass laminates, either combined with polyester resin or by itself and the polymer is growing rapidly as an oil additive.

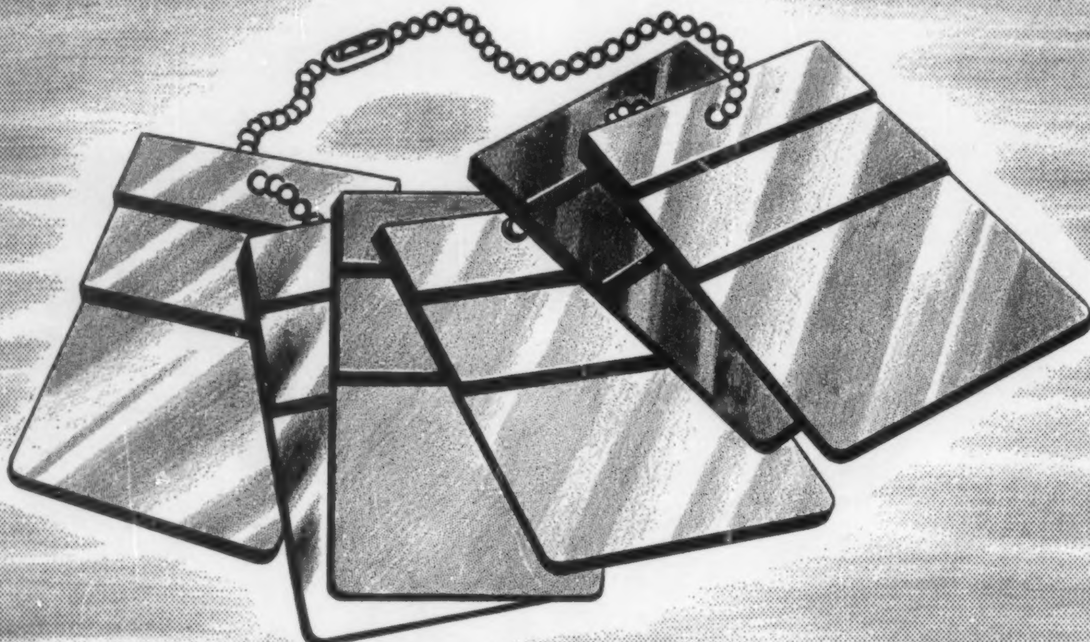
Catalin in Mexico. Completion of a five-year agreement for exchange of information and "know-how" between Catalin Corp. of America and Adhesivos Resistol, S.A., Mexico, has been announced. Specifically, Catalin will disclose to Adhesivos its formulas and technical information pertaining to manufacture and equipment in connection with phenolic, cresylic, resorcinol, melamine, and urea liquid resins for adhesives, textiles, and paper-treating purposes; the agreement will also be reciprocal.

Rigid PVC for foods. Calendered rigid vinyl sheet which may be used in direct contact with red meats, poultry, and sea food, as well as other products, has been developed by Bakelite Co. With this food-packaging-grade rigid vinyl, meat and poultry can be dressed and cut at the wholesale point, then shipped in sealed containers with clear top covers and placed directly on store shelves.

According to Bakelite, the Food and Drug Administration of the U. S. Dept. of Health, Education and Welfare, and the Meat Inspection Branch of the U. S. Dept. of Agriculture have voiced no objection to such use of the sheet, which is said to be easily and inexpensively vacuum formed into bowl, tray, and contour-following shapes. It can be heat sealed.

For additional and more detailed news see Section 2, starting on p. 252.

When the chips are down ....



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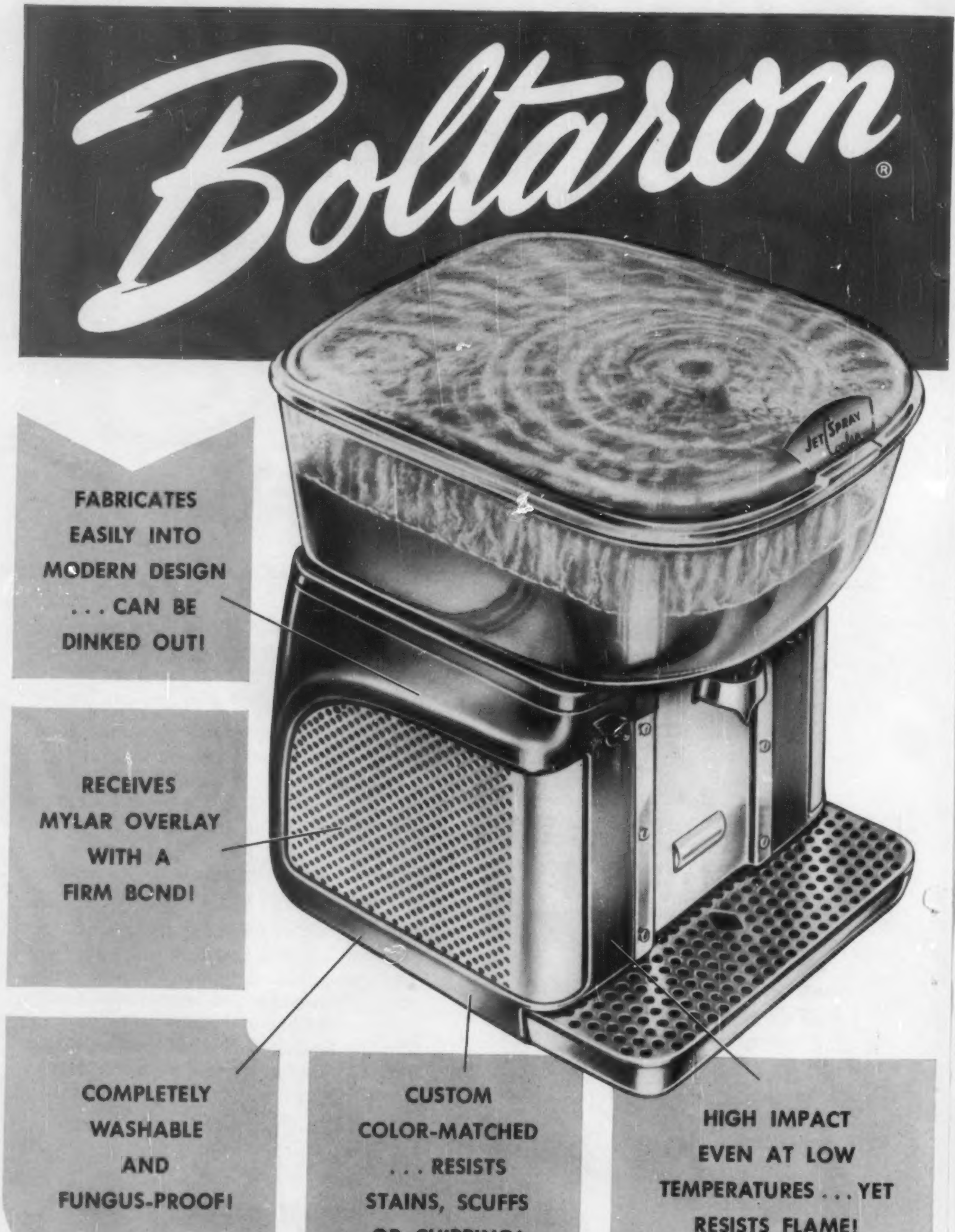
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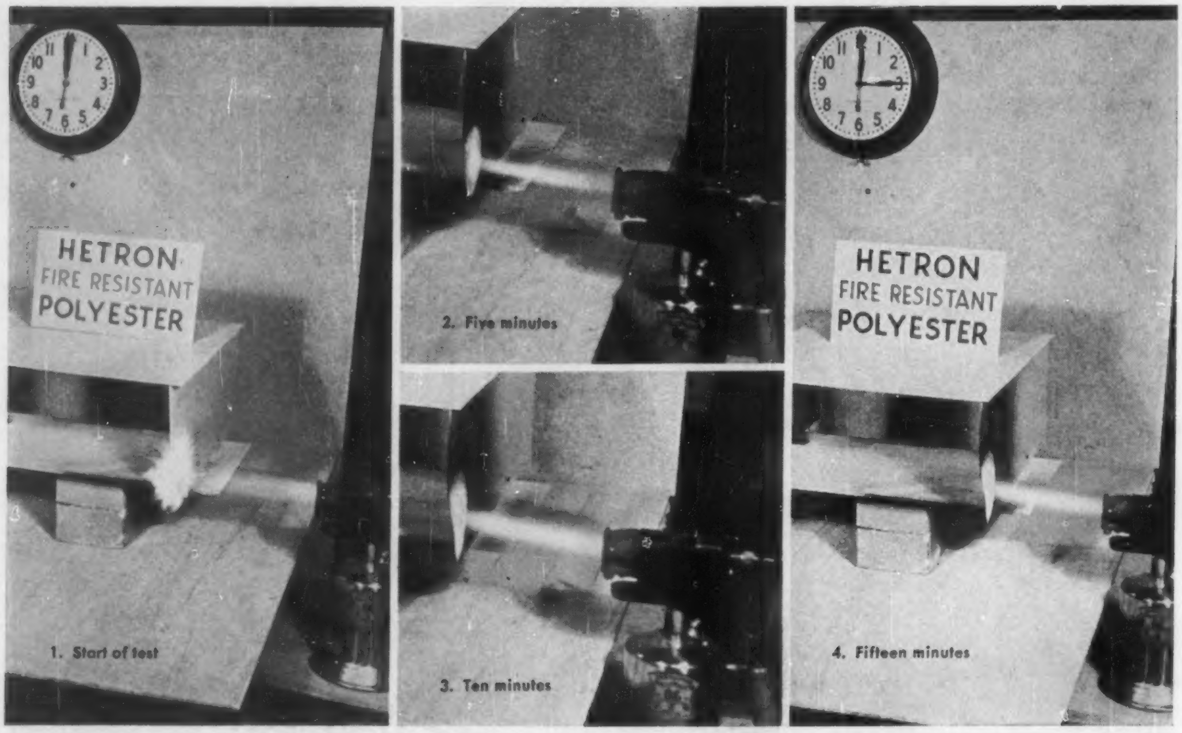
HIGH IMPACT EVEN AT LOW TEMPERATURES . . . YET RESISTS FLAME!



BLOWTORCH FLAME plays steadily on HETRON test structure for 15 minutes; can't start it burning.

New material for idea-men: **fire-resistant polyesters**

Want to engineer high strength plus *specific fire resistance* into a product? Take a hard look at HETRON® polyester resins.

You can use HETRON in many places where reinforced polyesters have not been practical heretofore. HETRON will not burn, except at the point where a hot flame is directly applied. It "snuffs out" as soon as the flame source is removed.

In exploratory tests, sheets of HETRON have shown flame spreads as low as 20 by ASTM E84-50T (Tunnel Test)—compared with ratings of 0 for asbestos board and 100 for red oak.

The versatile "family" of HETRON resins can be modified and blended by the fabricator, to make possible a whole galaxy of controlled physical properties. These resins combine fire resistance with outstanding flexural strength, tensile strength, heat resistance, and very low water absorption. Using light-stabilized HETRON, you can attain excellent resistance to weathering.

Some HETRON resins, including semi-rigid HETRON 32A, are manufactured to meet Military Aircraft Specification MIL-R-7575A, Types I and II. HETRON 92, with up to 10% added styrene, meets MIL-R-7575A, Types I, II, III.

New as it is, HETRON is already proving its merit in automobile and truck body panels and structural members; aircraft parts; large boat hulls; machine housings; radomes; electrical insulating board and parts; chemically resistant blowers, tanks and ductwork; "sandwich" structural and refrigeration panels; skylights, louvers, and industrial windows.

Is there a place in your designs for this unique combination of strength-plus-safety? To find out, write today for complete data file on HETRON resins. Ask also for names of fabricators who can supply you with HETRON parts.

Comparative Physical Characteristics
HETRON and 10 non-fire-resistant resins

Physical Property		Rigid Resins		Semi-rigid Resins
		HETRON 92	Avg. 10 Others	HETRON 32 A
Flexural Strength, PSIx10^3	Room Temp.	38.6	36.4	41.8
	180°F.	25.0	18.6	23.5
Flexural Modulus, PSIx10^6	Room Temp.	1.88	1.61	1.82
	180°F.	0.90	0.79	0.85
Tensile Strength, PSIx10^3		21.7	22.0	21.0
Water Absorption, Pct. by Wt.		0.13	0.29	0.13

SUPERIOR PHYSICALS of HETRON show up in exhaustive tests by independent, impartial laboratories. Panels 0.1" thick, made from HETRON and 10 leading non-fire-resistant resins, contained 35-40% glass mat, 17-20% filler, and the balance resin. Note that HETRON 32A, a semi-rigid resin, is compared with non-fire-resistant *rigid* resins.

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R.C.65. This machine is suitable for the production of lighter tubes and sections in thermoplastic materials. The machine will produce outputs of up to 75 lb. per hour dependent on the type of material and die construction
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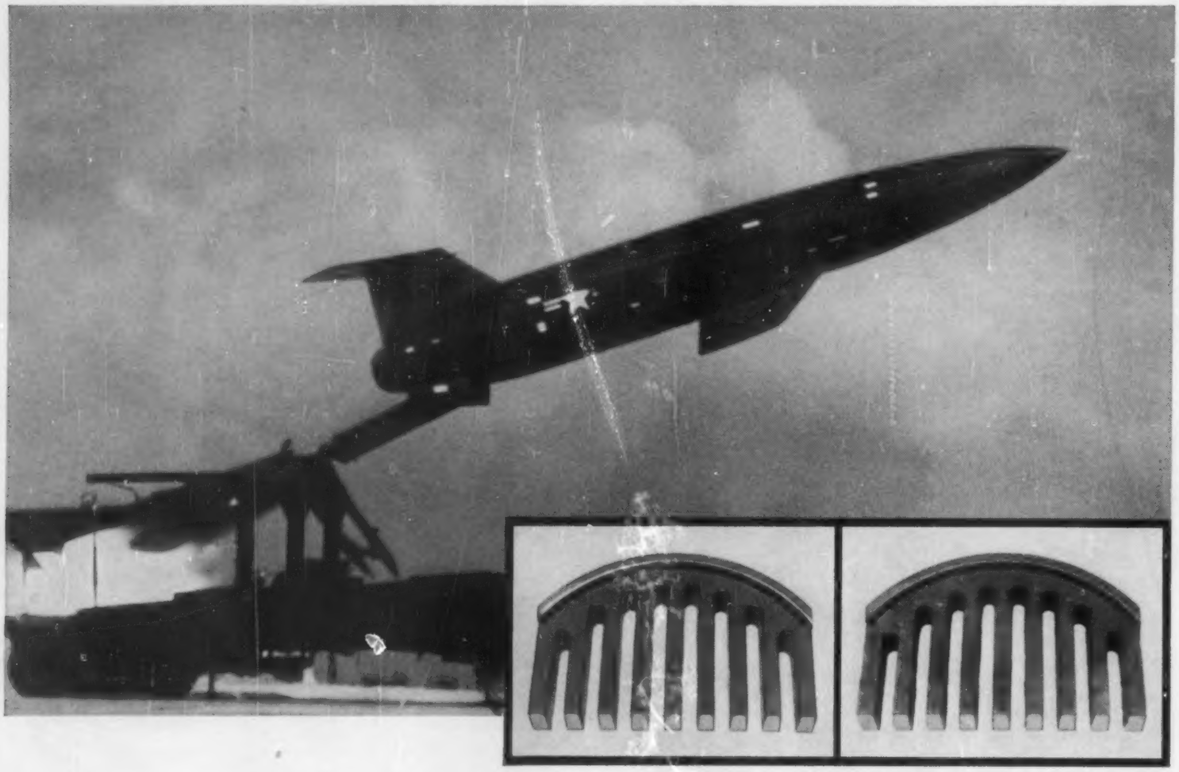

Left—"Sliver" trap cross-section showing condition before firing of the rocket.
Right—Cross-section of "sliver" trap after exposure to 2000°F rocket gas stream for 3 seconds. Only surface is affected by blast.

WANTED:

A low-cost plastic to withstand 2000°F

PROBLEM:

Rocket engineers face a serious problem when using solid propellants. Long, white-hot splinters of the propellant will sometimes be ejected from the rocket nozzle during blast-off unless they are stopped. These fiery slivers are a major hazard, and where the rocket is used as a jato unit, would seriously endanger the aircraft.

SOLUTION:

To solve this problem, designers use R/M Asbestos-Phenolic Molding Compound LS-9178. Gratings molded with this material hold the propellant in the rocket combustion chamber till it is properly burned. Fabricated at comparatively low cost, these traps today are successfully taking the intense heat of the rocket blasts, and are adding significantly to rocket safety and performance.

If your design demands *all* of the following features, find out more about the new family of R/M reinforced plastics (molding compounds, felts, papers, etc.):

1. Excellent resistance to heat and flame
2. High modulus of elasticity from low to high temperatures
3. High strength from low to high temperatures
4. Smooth, abrasion-resistant surfaces
5. Exceptional dimensional stability
6. Elimination or reduction of surface crazing of resins
7. Good insulation and thermal properties
8. Economical to fabricate

For further information, please write for technical bulletins

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TECHNICAL BULLETIN

CLAREMONT
RESEARCH
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date: SEPT. 1, 1956
subject.

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The "PE" series granular concentrated colorants

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BOONTON, NEW JERSEY

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CONNECTICUT OFFICE—P. O. BOX 486, TUCKAHOE 7, N. Y., WOODBINE 1-2109

MINI-JECTOR

TRADE MARK

PLASTIC INJECTION MOLDING MACHINES

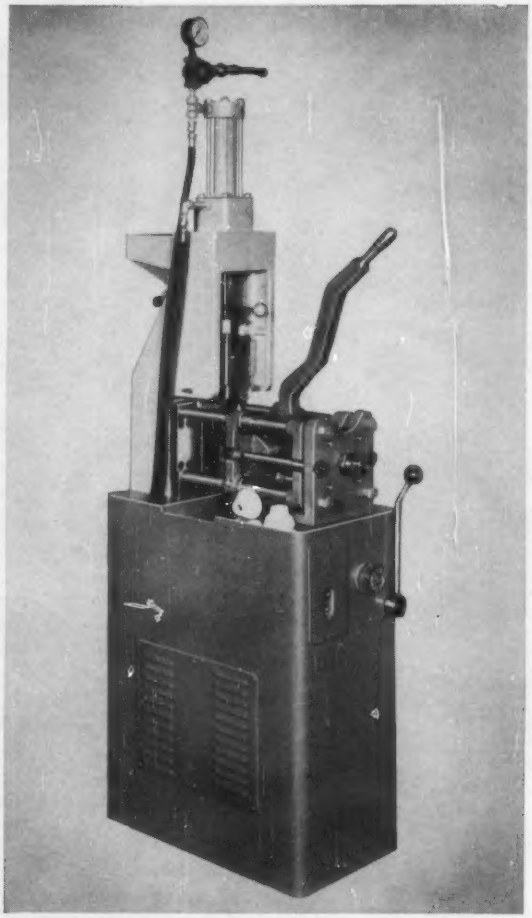
For Economical

MOLDING OPERATIONS ON SMALL JOBS

Mini-Jectors are small production machines. They offer the most economical way of injection-molding small plastic articles (¾ oz. or less) where there is no need for high-speed production.

In addition, Mini-Jectors are ideal equipment for developing new plastic products. You can make up a few dozen, several hundred, or thousands in the exact color and design to test market reaction before you tool up for full production. In many cases, the Mini-Jector will take care of the entire production requirements.

Any Thermoplastic including NYLON may be molded with a Mini-Jector.



MODEL 60 "HORNET" ¾ oz. injection capacity. Mold size 6" x 5" x 5⅛". Will plasticize 5½ lbs. per hour. Hydraulic injection system, also available for air operation . . . semi-automatic knockout speeds operation and mold change.

MODEL 45 "WASP" ¾ oz. capacity air-operated Mini-Jector . . . fast and economical. 6" air cylinder operates ram . . . 40 to 150 pounds of air pressure required depending on type of plastic used and product being molded. Material hopper capacity 4 pounds.

Mini-Jectors are available in two basic models, the "Wasp" and "Hornet" series. The "Wasp" series uses only the inexpensive "V" type mold which is removed once in each operational cycle. The "Hornet" series mold blank remains in the machine and the part is removed or ejected either manually or mechanically. "Hornet" mold blanks also provide more mold area.

The "Wasp" series are available for operation either manually, by air, or hydraulically. The "Hornet" series operates only by air or hydraulic systems.

WRITE TODAY . . . for literature telling how Mini-Jector may help solve your injection molding problems, to . . .

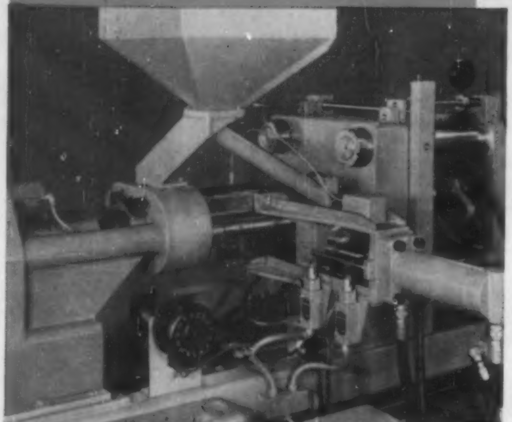
NEWBURY INDUSTRIES, 2023 Munn Road, Newbury, Ohio

"Specializing in the Production and Development of Plastic Injection Molding Machines of one ounce or less capacity"

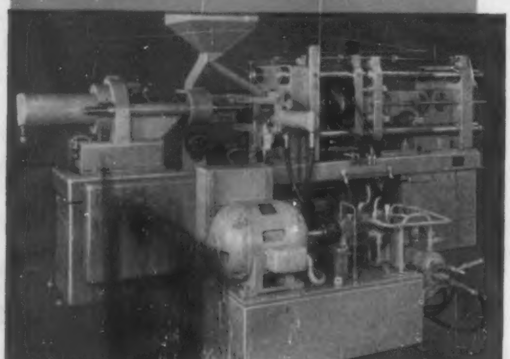
Export Distributors: OMNI PRODUCTS CORP., 460 4th Avenue, New York 16, N.Y.

EXCLUSIVE NEW PRE-PLASTICIZER

GIVES THE LEWIS "6P" OUTSTANDING CAPACITIES!



Lewis-designed pre-plasticizer provides accurate temperature control . . . assures uniform material viscosity . . . permits lower injection pressures.



Separate hydraulic power plant for pre-plasticizer stuffer unit can be installed adjacent to machine or in remote location.

COMPLETELY NEW CONCEPT FEATURED BY FIRST PRE-PLASTICIZER DESIGNED ESPECIALLY FOR AN 8-OUNCE MACHINE

It's the talk of the trade . . . the new LEWIS 616-PP-12! Offering exclusive operating advantages, it is the first production machine capable of molding the new low-pressure linear-type polyethylene. It scores another "first" by coupling a new type pre-plasticizer with the famous "Hydra-Lock" clamp . . . an unbeatable combination for volume production of large precision moldings.

Pre-plasticizer's design permits use of injection pressures 60% to 70% lower than conventional pressures. And . . . pressure holding after injection is eliminated by a new nozzle shut-off valve. In addition, because heating chamber temperatures average only 45° F. higher than material's temperature when ejected, *the machine's normal cycle can be interrupted indefinitely without burning the material or changing its viscosity.*

These are only a few exclusive LEWIS "6P" features. Write for BULLETIN 106 . . . or call KEnmore 1-3040 . . . for specifications and prices.

LEWIS 616-PP-12 CAPACITIES

DRY CYCLE (strokes/hour)	360
OUNCES/SHOT (polystyrene)	22
CUBIC INCHES/SHOT (maximum)	36
PLASTICIZING CAPACITY (lbs./hour)	145
MOLD CLAMPING PRESSURE (tons)	200
PRESSURE ON MATERIAL (p.s.i.)	25,000

LEWIS

THE LEWIS WELDING & ENGINEERING CORP.
MACHINE DIVISION
23002 St. Clair Avenue • Cleveland 17, Ohio


The World uses Araldite®
Switzerland
Anti-aircraft guided missiles constructed with adhesives formulated from Araldite epoxy resins in accordance with the most up to date principles in the field of structural adhesives.
Manufacturer: Werkzeugmaschinenfabrik Oerlikon Bührle & Co., Zürich-Oerlikon.
CIBA
First in Epoxies
Ciba Company Inc.
Plastics Division
Kimberton, Pa.

F-B® Inclined "Z" calender improves efficiency of "accepted standard" film production line

Continuous flow of material is vital to successful production of plastic film or sheet. In calendering, particularly, once proper running temperature has been reached and the gauge set, interruption of scheduled production is costly.

With this in mind, Farrel-Birmingham engineers, working with plastics manufacturers, developed the Matched Production Unit, to synchronize the progressive steps in the production of plastic film. These layouts are comprised of processing machines matched in capacity to prevent *choking* or *starving* of succeeding units. Production flows without costly interruption. Manual aid and supervision are cut to a minimum.

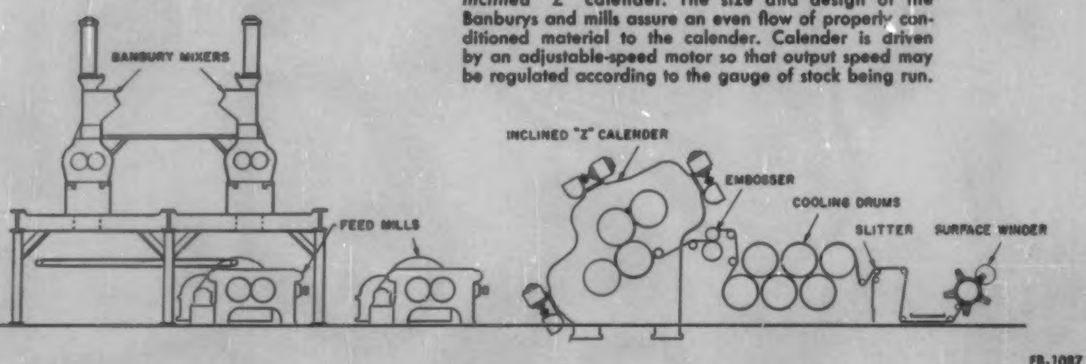
Farrel-Birmingham Matched Production Units have given such satisfactory service that they have become generally accepted as standard equipment for high-speed, accurate-gauge production of film. Capacities and design features of individual machines for any production line can be suited to the particular requirements of the customer.

new standards for accuracy, quality and speed in the production of plastic film. This machine performs the delicate task of calendering film at high speed and temperature, to a gauge as thin as .002" and less, within tolerances of plus or minus .0001".

Advantages of the "Z" calender include: (1) "Z" arrangement of the rolls isolates the separating forces. With only two rolls in any plane, there is no pressure from a third roll to affect roll settings and cause fluctuation in gauge. (2) Motorized crossed-axes device provides widest range of "crown" adjustment with maximum accuracy of gauge. (3) Hydraulic preloading devices anchor rolls in their fixed loaded positions in precision bearings.

Send for more information about Farrel-Birmingham's newest development – the *inclined* "Z" calender. Or, if you prefer, company engineers will be glad to discuss your overall production objectives with you. They will help you choose a Matched Production Unit that's right for your needs.

Matched Production Unit consisting of two 3A Banbury® mixers, two 22" x 60" mills and a 28" x 66" four-roll *inclined* "Z" calender. The size and design of the Banburys and mills assure an even flow of properly conditioned material to the calender. Calender is driven by an adjustable-speed motor so that output speed may be regulated according to the gauge of stock being run.



The Farrel-Birmingham four-roll inclined "Z" calender is a recent and outstanding contribution to the efficient conversion of raw material to finished product. It provides improved operating conditions while retaining the inherent advantages of the original F-B "Z" calender.

The angle of the rolls makes threading easier – facilitates access to the rolls for operation and for installation of auxiliary equipment. As an integral component of the Matched Production Unit (see diagram) the *inclined* "Z" calender offers even smoother-flowing production – promises maximum processing efficiency.

The origination and development of the "Z" calender by Farrel-Birmingham established

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
Sales Offices: Ansonia, Buffalo, Akron, Chicago, Fayetteville (N. C.), Los Angeles, Houston

F-B PRODUCTION UNITS – Banbury Mixers • Roll Mills • Calenders • Extruders • Horizontal and Vertical Injection Molding Machines • Transfer Molding Machines • Compression Molding Machines

Farrel-Birmingham®

"Poly-Eth" Builds Markets For You:

Big new markets for polyethylene in the construction field have been stimulated by this Spencer Chemical Company advertisement in leading national magazines. Nearly 6,000 builders and home owners responded to the ad. And many of them have already become new customers for polyethylene film.

Every new market for polyethylene helps make your business just that much better. And "market-building" is just one of the many services provided by Spencer. Why not find out about all the advantages of Spencer "Poly-Eth"* polyethylene? Just drop us a line at 660 Dwight Bldg., Kansas City 5, Mo.

Poly-Eth by **SPENCER**

*A registered trademark of Spencer Chemical Co.

Polyethylene

AMAZING NEW USES FOR WONDER PLASTIC

Waterproof Rug: cure for a chamber of horrors.

RECENTLY Business Man Ed Hubbard of Memphis, Tennessee, found himself in a worse fix than Poppa Bear of Goldilocks fame. For something invisible was eating away his house.

His trouble, it turned out, was one which is shared by many homeowners —whether they know it or not—if they have crawl spaces rather than basements under their houses. The villain was that ever-present threat to home security—moisture vapor. In this case the moisture vapor was rising from the ground under the crawl space.

INVISIBLE SPRING. Tests indicate that the ground area under almost any crawl space is an invisible spring, producing as much as nineteen gallons of water vapor every twenty-four hours.

Such moisture vapor, Hubbard found, causes a whole chamber of horrors about which the homeowner usually knows nothing until too late. For instance, this vapor can cause floors to buckle, steel beams to rust and joists to rot. It can even make plaster inside the house get damp and crumble.

Luckily for Hubbard, E. L. Bruce Co., world's largest producers of hardwood flooring, showed him a ridiculously easy solution to his problem.

That solution is simply to put down under the house a layer of 4 mil polyethylene film. You use rolls three to six feet wide. Just unroll it on the ground, allowing three to six inches overlap. The film doesn't even have to be covered,

Salesman Bill Brooks and "Poly-Eth," Spencer's symbol for polyethylene.

Eleven hundred square feet of polyethylene—a good average figure for underhouse areas—costs about fifteen dollars. One man can lay it in about an hour and a half. And the plastic film, when put down, gives you virtually 100% protection against under-house moisture vapor.*

BUILDING BOOM. According to latest reports received by Spencer Chemical Co., makers of "Poly-Eth"† polyethylene, this new wonder plastic has also solved a whole flock of other problems that frequently confront the builder.

For example, in slab on grade construction, the only adequate moisture barrier between a concrete floor and a top-flooring has been a hot-mopped membrane of asphalt-saturated felt.

But if a layer of 2 mil polyethylene film is used as the membrane, it can be held down by a cold cut back floor adhesive and is less expensive and easier to use. For instance, Jack Rhue, Memphis flooring contractor, recently primed a floor space of a hundred and twenty-five square feet, spread the mastic, laid the film, and put down the hardwood blocks—all between nine and three o'clock.

Normally this would have been a two day job. And creating a moisture barrier with polyethylene cost him only about a fourth to an eighth as much as the hot-mopped process.

NO WET BLANKET. Called "the most enduring barrier against vapor and moisture that money can buy," a film of polyethylene can be expected to last the lifetime of a building.

*For more details, send for free Spencer booklet, "Polyethylene for Home Builders and Home Owners."

†A registered trademark of Spencer Chemical Company.

When used as waterproofing for basement or foundation walls, the film adheres to the concrete and stays put when the forms are removed. The forms need no varnishing or greasing, and no other waterproofing is needed.

Used over concrete slabs that are drying, polyethylene film prevents the flaws that result from uneven curing. In hot dry climates, it keeps concrete from drying too quickly.

Because polyethylene is the lightest of all non-foam plastics (a thousand square feet of 4 mil film weighs less than twenty pounds) and because it comes in extra big sheets, it is so easy to handle that it greatly reduces labor costs—sometimes by as much as 50%.

BUILDING FRIENDS FOR YOU. If you're doing any kind of building, either in your business or around your home, you'll probably find polyethylene film can help you in a dozen ways. Why not send for the free Spencer bulletin, "Polyethylene for Home Builders and Home Owners"? Spencer Chemical Company will also be glad to send you information about suppliers of polyethylene film.

FACTS FREE

If you'd like to know more about "Poly-Eth" Polyethylene, check the items below in which you are particularly interested. Then mail this coupon to "Poly-Eth," Spencer Chemical Company, 660 Dwight Bldg., Kansas City 5, Missouri. We'll send you more information by return mail.

- ☐ Polyethylene for Home Builders and Home Owners
- ☐ 58 Home Uses for Free Polyethylene
- ☐ Polyethylene for Packaging
- ☐ Lawn Sprinkler Systems

SPENCER CHEMICAL COMPANY

660 Dwight Bldg., Kansas City 5, Mo., Manufacturers of "Poly-Eth" Polyethylene • Ammonia (Commercial and Refrigeration Grade) • Aqua Ammonia • 83% Ammonium Nitrate Solution • Synthetic Methanol • Formaldehyde • Hexamine • "Mr. N" Ammonium Nitrate Fertilizer • SPENSOL (Spencer Nitrogen Solutions) • FREZALL (Spencer Dry Ice) • Cylinder Ammonia

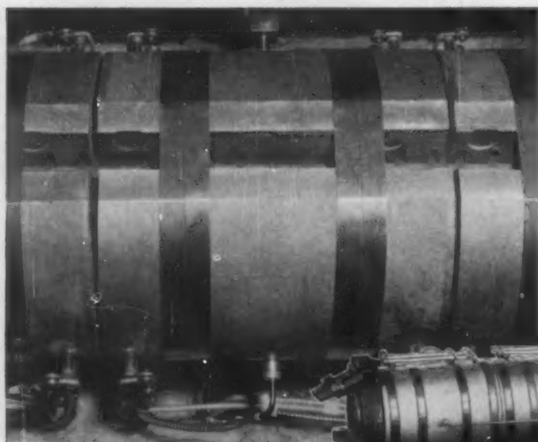
NRM thermoplastic EXTRUDERS

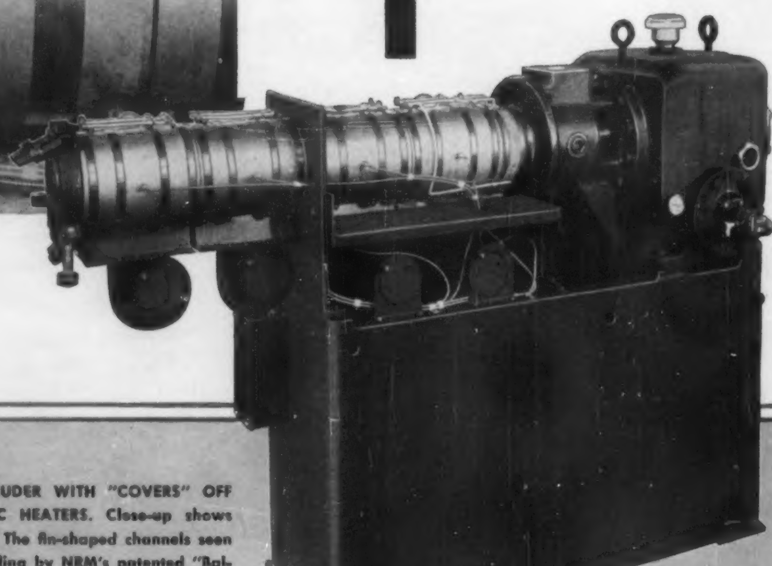
with

Cast-in Heaters

assure

- **Less Extruder *"DOWN TIME"***
- **Increased Production**
- **Higher Quality Extrusions**





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NRM THERMOPLASTICS EXTRUDER WITH "COVERS" OFF SHOWING CAST-IN ELECTRIC HEATERS. Close-up shows installation and wiring detail. The fin-shaped channels seen in the castings are for air-cooling by NRM's patented "Balanced Heat Control."

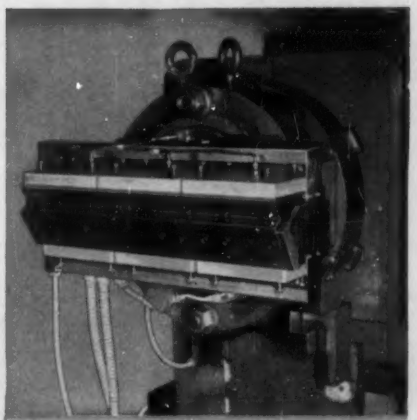
Check these reasons why . . .

UNIFORM HEAT TRANSMISSION — The continuous, uniform flow of heat so vital to quality plastics production is assured by NRM's system of cast-in heating. It consists of a series of half-circle aluminum castings like the one shown in the diagram. These clamp together to "jacket" the entire length of the cylinder. Balanced spacing of heating elements, and high conductivity of the aluminum assures equal distribution of heat throughout the casting, or "shell." Inner faces of the shells are machine-fitted to the cylinder, thus providing a virtually unobstructed and *uniform* flow of heat from the heat source to the plastic.

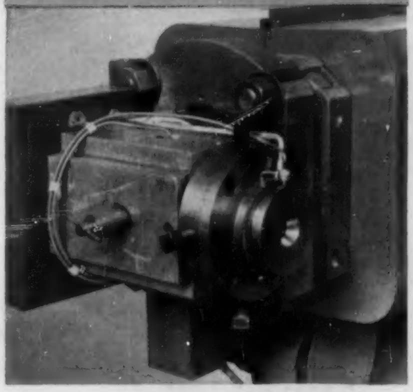
QUICK RESPONSE TO CONTROLS — There are no alternate "hot and cold" phases with NRM's cast-in heating. The aluminum shells store heat at controlled temperature, thus providing continuous heat to the plastic, even during the "off" cycle of the control system. Replenishment of the "stored" heat is almost instantaneous when heat input starts again.

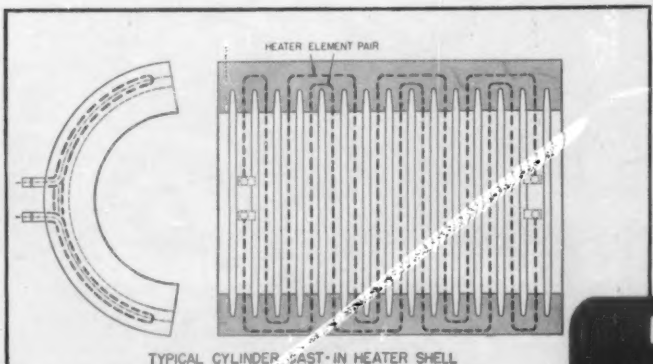
LONG LIFE OF HEATERS — Burn-outs, melt-outs, or almost *any* kind of heater failure is a rarity in NRM Extruders . . . Cast-in heaters have their elements safe *inside* their bodies . . . terminals are located safely away from the heat source, and connecting wires cannot become oxidized by ambiant heat. With less "down-time" for heater repair or replacement, you get substantially more *production* time from NRM Extruders.

PRACTICAL DESIGN — NRM's cast-in heater system permits compact, readily accessible installations . . . easier operation . . . space saving Extruders. Products of advanced electrical and metallurgical egineering, cast-in electric heaters provide the utmost in extruder efficiency, dependability and economy. That's why they are a *standard feature* on NRM Electrically Heated Extruders in all sizes.



NRM gives you the advantages of cast-in heating on many types of dies. Shown above is a pelletizing die, and below, a crosshead. Both are more compact and efficient with cast-in heating.





TYPICAL CYLINDER CAST-IN HEATER SHELL

2548

WRITE TODAY...

for more information on the NRM full line of Thermoplastic Extruders and Equipment. See for yourself how the many important NRM design and operating features — like cast-in heaters, for example — help make plastics extrusion more profitable.

NRM

NATIONAL RUBBER MACHINERY CO.

General Offices and Engineering Laboratories: 47 West Exchange St., Akron 8, Ohio. HEmlock 4-1961

EAST: 384 Getty Ave., Clifton, New Jersey.

SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.

WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.

MID-WEST: National Rubber Machinery Co., 5875 North Lincoln Ave., Chicago 45, Ill.

CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St. West, Toronto, Ont.

EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.

DIME OR DOLLAR SIZE...

ROLL DISPENSED

Pressure-Sensitive LABELS

YOUR Roll Label Printer
is a specialist in this field. His specialized "know-how" is based on years of experience and study in connection with designing and printing *labels that sell!*

He prints on KLEEN-STIK pressure-sensitive paper stock, using specially-built equipment, to provide you with labels that will keep your production lines rolling at top speed. Practically any size . . . any shape . . . any stock — for fast, easy application without the use of water, glue or heat. For low-cost, high-impact labeling on your product or package, see your Roll Label Printer.

FREE! TEST-IT-YOURSELF KIT

Contains a selection of pressure-sensitive samples for on-the-spot testing in your own plant. Write today!

direct from the ROLL LABEL SPECIALIST of your choice

Pressure-sensitive roll labels in specially designed dispensers give you the *world's fastest known* method of hand labeling. Available through your Roll Label Printer in automatic, semi-automatic, or hand-operated models to suit every need.

KLEEN-STIK PRODUCTS, INC.

7300 WEST WILSON AVENUE • CHICAGO 31, ILLINOIS

Pioneers in Pressure Sensitives for Advertising and Labeling

"Pittsburgh Fiber Glass Type 508 Roving helped us improve product quality, reduce rejects and increase output 25%"

. . . says Mr. Charles D. Jones, President
Structurlite Plastics Corporation
Hebron, Ohio

Mr. Charles D. Jones, President of Structurlite Plastics Corporation, holds a pre-form and a molded plastic safety helmet made with Pittsburgh Fiber Glass Type 508 Roving.

Resin is poured over the pre-form in preparation for molding an industrial light shade in a 100-ton hydraulic press. Pittsburgh Roving is uniform, soft and easy to handle.

Structurlite Plastics Corporation prides itself in producing quality glass-reinforced plastic products, ranging from school desk units and industrial light shades to juice dispensers and baseball protective caps. And Pittsburgh Fiber Glass Type 508 Roving is a major factor in assuring this quality production.

Mr. Jones reports, "The unusual softness and pre-forming quality of Pittsburgh Type 508 Roving reduces the amount of binder required in the pre-form to help it keep its shape. The lesser amount of binder results in a more durable merchandise and a better appearing product.

"We began using Type 508 Roving in 1953. Rejects which previously ran as high as 12 per cent were reduced to five per cent. This Type 508 Roving has helped increase output as much as 25 per cent. To say we are pleased with its performance is putting it mildly."

WHAT CAN PITTSBURGH TYPE 508 ROVING DO FOR YOU?

If you are not satisfied with the reinforcement you are now using, perhaps Pittsburgh Type 508 Roving can offer you similar production advantages. We will be glad to arrange "in your plant" tests by our technical staff. Contact our executive offices or one of our district sales offices listed below. *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

PITTSBURGH FIBER GLASS TYPE 508 ROVING IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

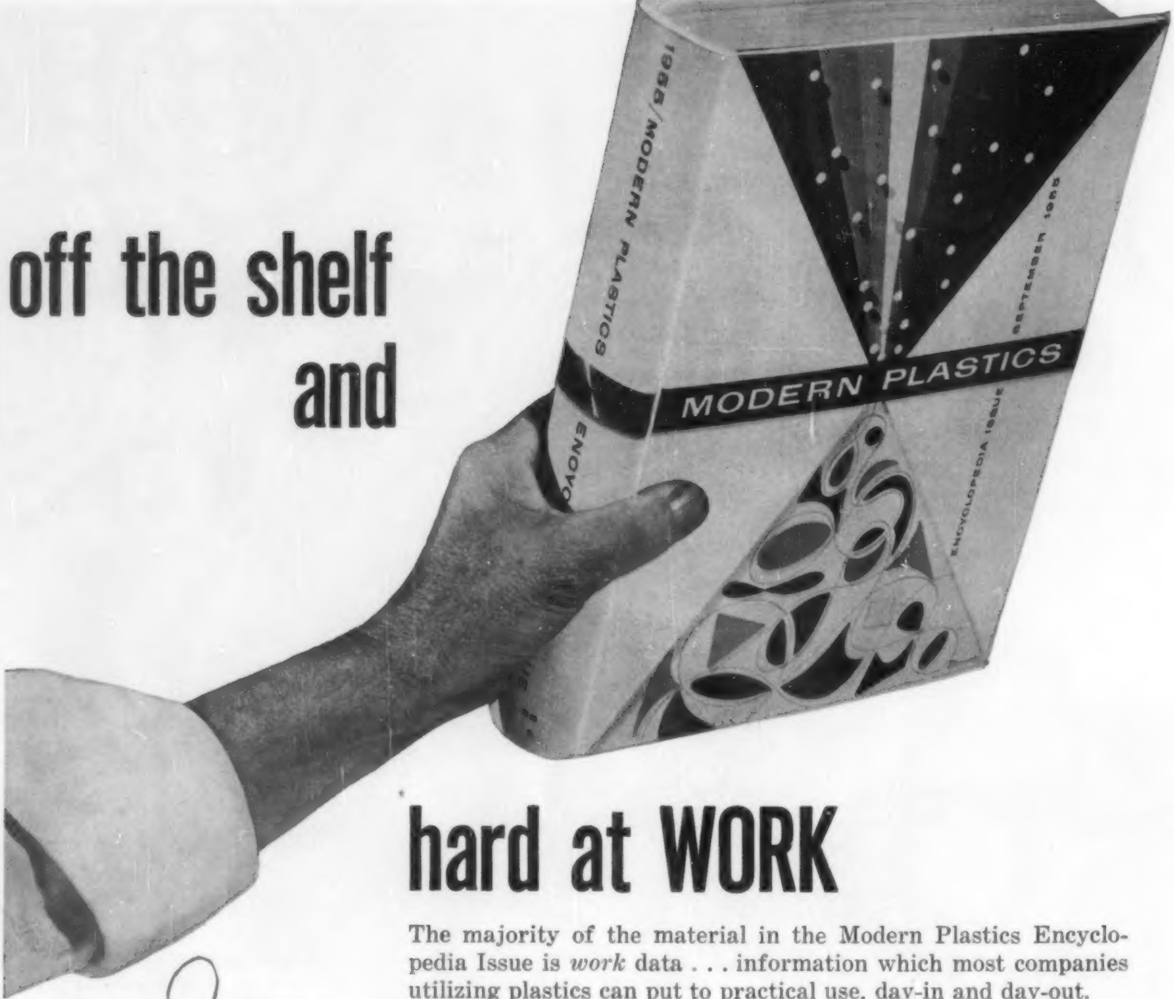
Sales offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, New York, Philadelphia and St. Louis

FIBER GLASS

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS

PITTSBURGH PLATE GLASS COMPANY

off the shelf and



hard at WORK

The majority of the material in the Modern Plastics Encyclopedia Issue is *work* data . . . information which most companies utilizing plastics can put to practical use, day-in and day-out.

This 1,006-page volume gives complete coverage to such important subjects as the characteristics of plastics materials, and the employment of fillers for lowering the cost and increasing the strength of plastics parts. Plastic coatings and foamed plastics are discussed exhaustively, as are all important finishing and decorating methods. Of course, the new cost-reducing slants on vacuum forming, deep drawing, injection molding, extruding and other production techniques are explained, too.

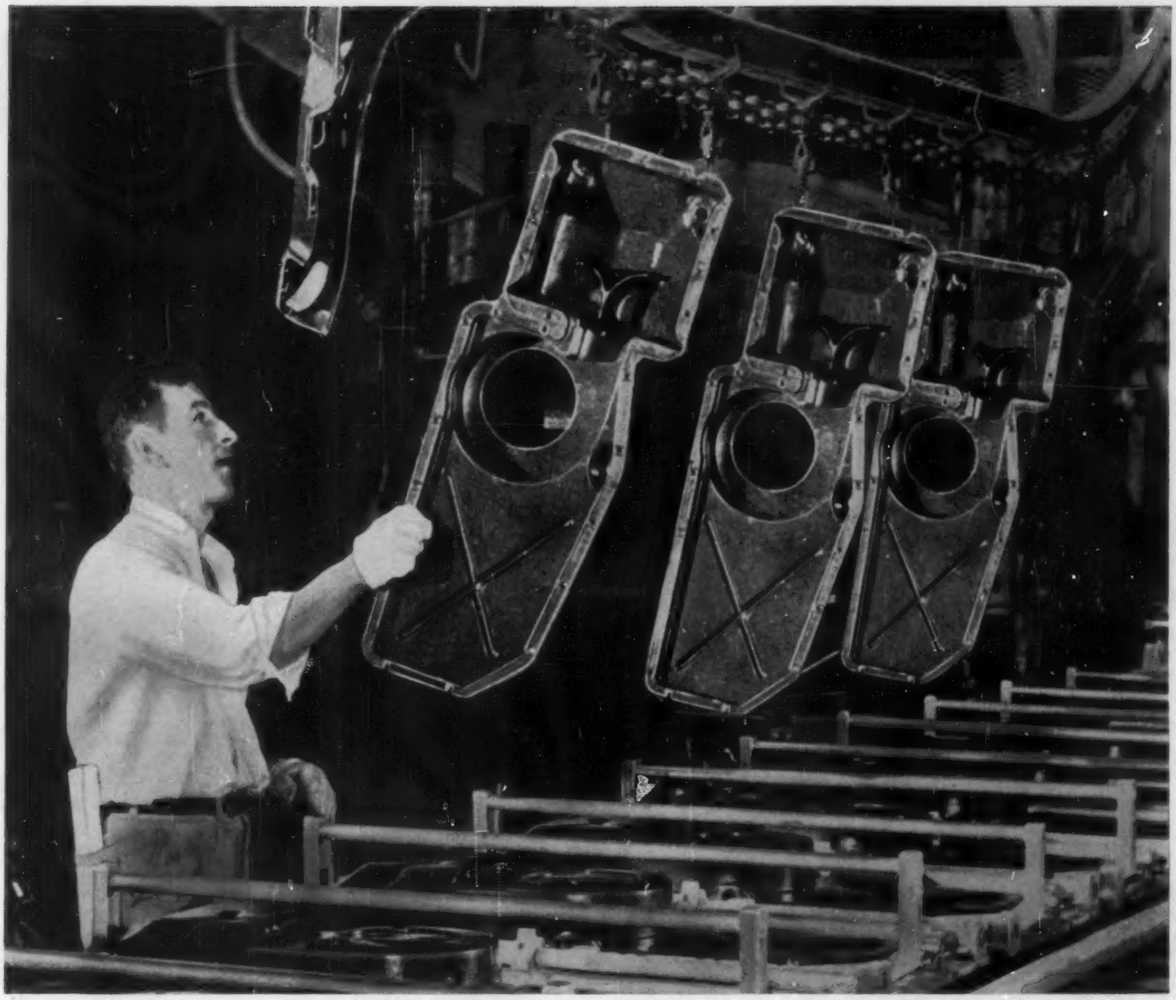
Countless hours of hunting for sources for resins, machinery, equipment and custom services such as molding, fabricating and decorating can be saved by referring to the world-famous Directory Section. It is thoroughly indexed for fast reference. The many ads also help lead you to qualified suppliers.

On the shelf your Modern Plastics Encyclopedia does you no good; at *work* it can be one of your most valuable production tools. Use it often!

Don't Overlook the Helpful Plastics Charts

Nine important charts summarize technical data on plastics films, adhesives, coatings, laminates, plasticizers and other vital topics. The plastics properties chart, perhaps the most referred-to section of the Encyclopedia, measures 45″ x 28″ and is suitable for wall mounting.

MODERN PLASTICS
A Breskin Publication
575 Madison Ave., New York 22, N. Y.

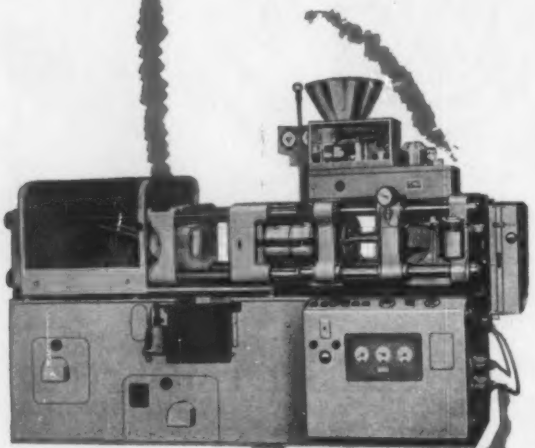


It sure pays

to approach us with your

production problems

because



BSM 40 s 2 ozs.

Battenfeld fully automatic Injection Molding Machine

this machine

Model BSM 40 S equipped with special dosing scale - built in series - is the most prominent one in Europe and a symbol and basis for up-to-date and efficient performance,

+ *our advice*

on the construction of your molds. We have a mold building division, expertly run and ready to work on your requirements, too,

+ *our service*

the best you can imagine and renowned in all parts of the world. Our servicing engineers will install the machine you order and will supervise its initial production upon request

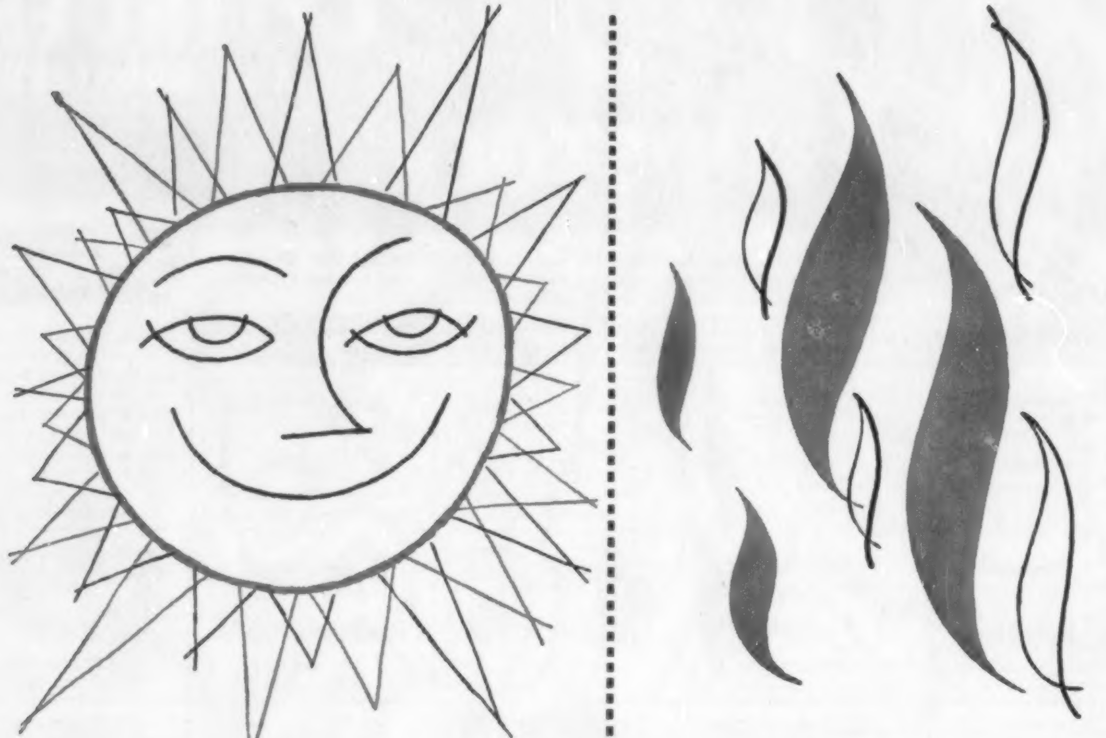
100 % solution

BATTENFELD

Injection Molding Machines, 1/4 up to 50 ozs.

(electro-mechanical drive)

MEINERZHAGEN/WESTF. · GERMANY



light heat

Safeguard vinyl extrusions against both with "Dutch Boy" Stabilizers

One "Dutch Boy" Stabilizer or another offsets the two major deteriorants affecting quality of extruded vinyl products.

Take "Dutch Boy" Dyphos® in vinyl clothesline. It provides outstanding resistance to the ultraviolet action of sunlight. Offsets the effects of high process heats.

The addition of "Dutch Boy" DS-207® to these same formulations contributes to the light and heat stability and also aids extrusion characteristics.

So it goes. "Dutch Boy" Dythal improves extrusions subject to high heat. "Dutch Boy" Provinite improves clear compounds. Then there's a whole family of "Dutch Boy" Stabilizers that are specifics for all types of extruded vinyls . . . from electrical insulations to clears.

Each of these "Dutch Boy" Stabilizers aids total compound performance. Each adds desired product qualities.

For specific recommendations, for basic formulation assistance, contact National Lead's Technical Staff.

Dutch Boy® CHEMICALS

NATIONAL LEAD COMPANY

111 Broadway, New York 6, N. Y.

In Canada: CANADIAN TITANIUM PIGMENTS LIMITED
630 Dorchester Street, West, Montreal
1428 Granville Street, Vancouver 2, B. C.

ERIE CUSTOM MOLDED *plastics* FOR SPORTS AND PLAY

These helmets, for teen-age, high school, college, and professional use, are molded for Tucker Brame Athletic Manufacturing Co., Batesville, Mississippi.

PLASTIC products are good only in terms of use. The molder must know the raw materials best suited for each individual application, as well as efficient and economical molding techniques. Here PLASTICS do the job . . . ERIE has the "know-how."

It's hard to tell whether the hobby horse of the lively youngster or the football helmet in battles on the gridiron gets the rougher treatment. Both are practically indestructible.

Ruggedness, a primary requirement, has to be molded into these two tough plastic parts because of the great impact and abuse that each will receive.

Both moldings are produced in our plant at Holly Springs, Mississippi, conveniently located to serve the fast growing industrial South. Regardless of your location, Erie is prepared to produce your custom molded plastic requirements at either our Holly Springs or Erie plant.

"The Wonder Horse, the Original Spring Suspended Hobby Horse," is molded for Wonder Products Co., Collierville, Tennessee.

ERIE *plastics*

ERIE PLASTICS DIVISION

ERIE RESISTOR CORPORATION

Main Offices and Factories ERIE, PA.

Manufacturing Subsidiaries

HOLLY SPRINGS, MISSISSIPPI • LONDON, ENGLAND • TRENTON, ONTARIO

A REPORT FROM KELLOGG ON

Results of electrical tests on Grade 500	
VOLTAGE BREAKDOWN	**VOLTS**
Initial volts	13,500
at 150°C.—1 week	13,000
2 weeks	14,600
at 175°C.—1 week	13,500
2 weeks	14,500
at 190°C.—1 week	11,300
2 weeks	9,600

New Fluorocarbon Plastic Formulation Provides Wire Insulation that can withstand Continuous Operating Temperature up to 175° C.

KEL-F PLASTIC, Grade 500—like all the molding compounds in the KEL-F fluorocarbon series—is notable for its extreme resistance to high temperatures, chemical attack, humidity and abrasion.

Of special interest to the electrical field is the higher heat-aging level of wire coatings with the new Grade 500. Tests on wire insulation indicate a continuous operating range of temperatures up to 175°C. Samples of coated wire exposed to temperatures as high as 190°C. for extended periods of time (2-3 months) still maintain relatively high voltage breakdown values.

Results of these electrical performance tests are summarized in the table above. An examination of the breakdown voltages after continuous exposure to high temperatures points up the high heat-aging level reached by KEL-F PLASTIC Grade 500 coated wire.

TWO TYPES AVAILABLE

KEL-F PLASTIC GRADE 500 is produced in two distinct types:

GRADE 500-F, a less crystalline type that resists embrittlement by high temperatures. Recommended for general wire and cable insulation, hook-up wire, thin wall tubing, and spaghetti.

GRADE 500-R, possesses same general properties as F type, only a slightly more rigid formulation. Recommended for use in connector insulation and for coil forms.

MOLDABILITY

The new Grade 500 permits extrusion of high molecular weight coatings and thin wall tubing that resist embrittlement when exposed to higher temperatures. Less crystalline in structure, Grade 500 can be fabricated without danger of splitting or crazing when heated. The flexibility of Grade 500 coated wire is also slightly improved.

TECHNICAL SERVICE

KEL-F PLASTIC Grade 500 is a result of Kellogg's comprehensive research in the field of fluorocarbon chemistry. Our technical staff will be happy to work with you in developing specific applications for the new Grade 500.

REPORT ON KEL-F PLASTIC, GRADE 500

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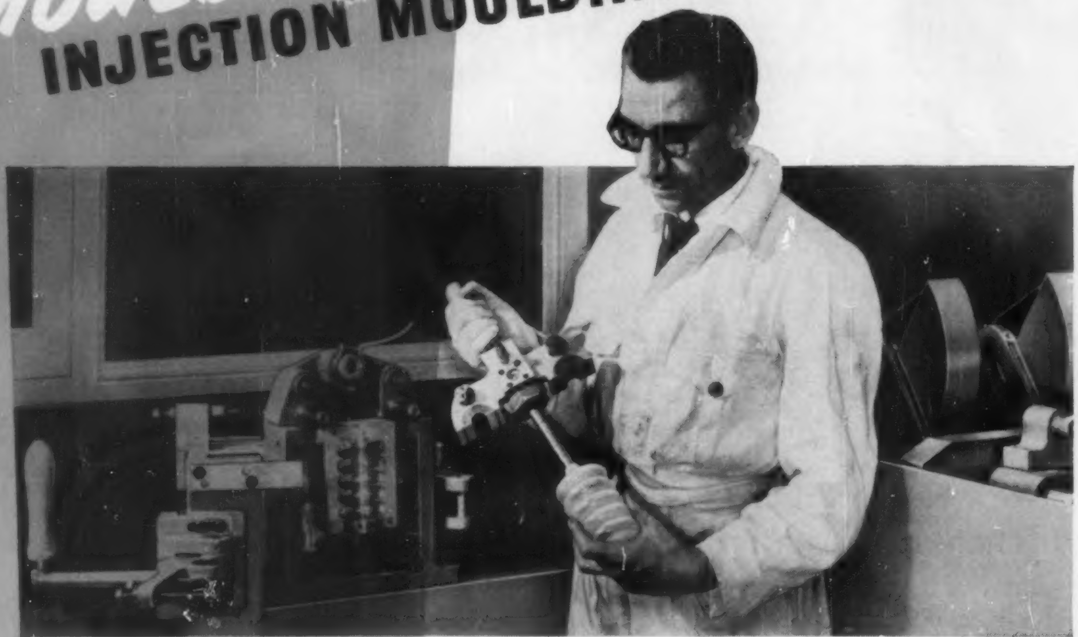
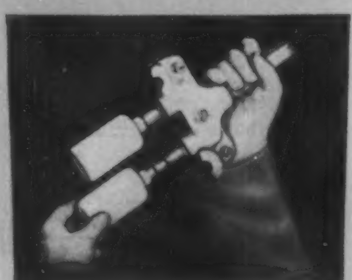


Blow stick showing 2 litre square bottle



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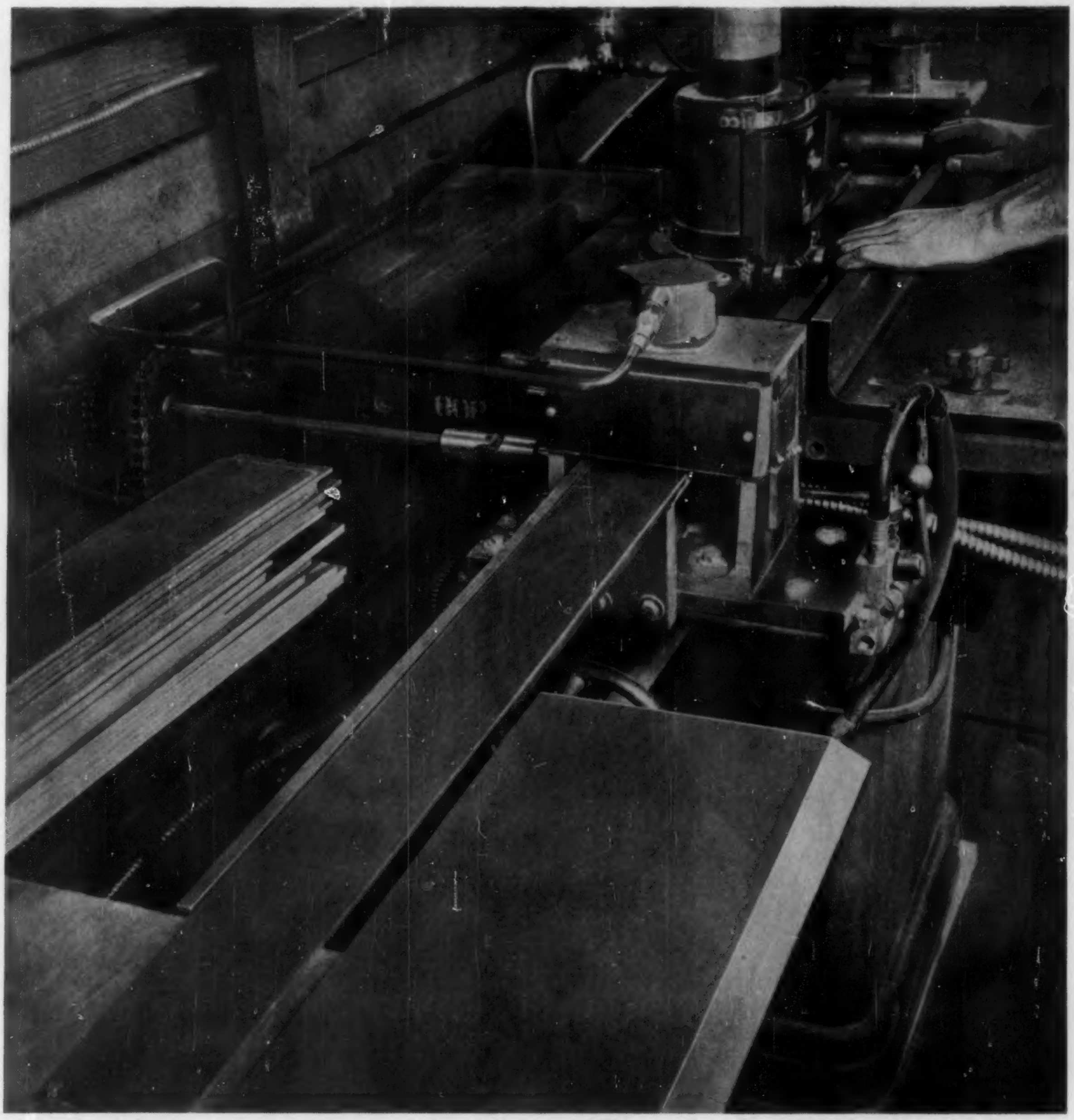

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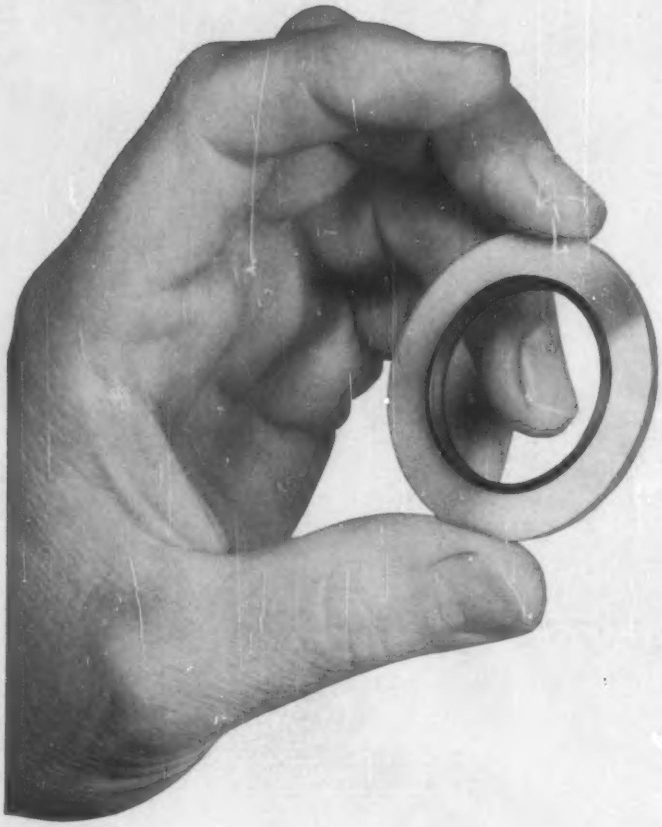
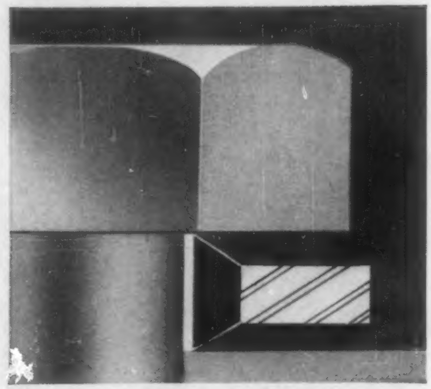
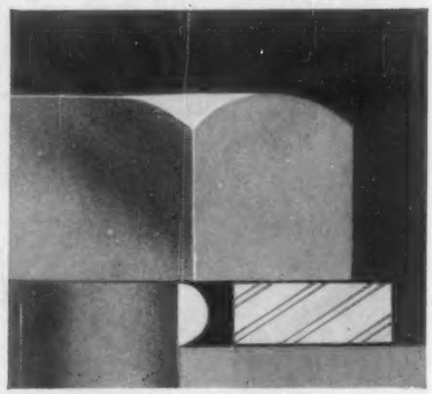




Seal before compression



When bolt is tightened, sealing lips are forced against surface.

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MODERN PLASTICS
Volume 34
September 1956
Number 1

Formable styrene alloy sheets gain new markets with

Reverse-printed overlays

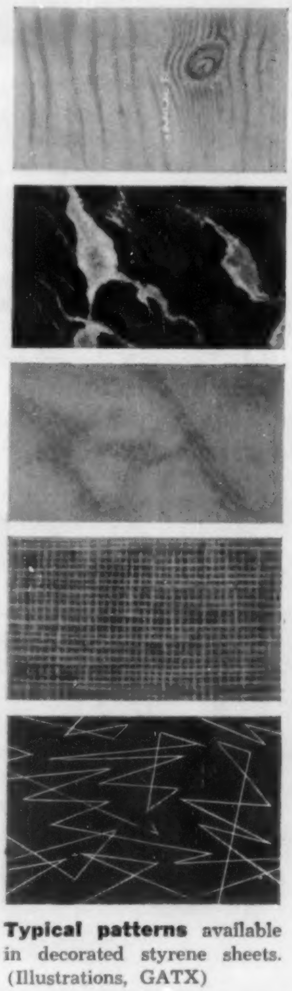
Commercial development of techniques for decorating styrene alloy sheet by laminating a reverse-printed overlay to the face of the sheet is only months old—but, on the basis of initial response to the material by end-users, market analysts are already revising drastically upwards their estimates of future sales potential for extruded high-impact styrene sheet.

With such large-volume, stable markets as the wall covering, refrigerator, automotive, furniture, and display fields already opening their doors to the new materials, predictions are that, by 1960, the new decorated sheet will have caught up with non-decorated styrene sheet in sales—thereby doubling the over-all market.

The future for this versatile new material is only now beginning to shape up. Although nearly every extruder in the country is working with predecorated sheet materials on an experimental basis, only a handful have thus far announced production. These include: Campco Div., Chicago Molded Products Corp., Chicago, Ill.; Plastics Div., General American Transportation Corp., Chicago, Ill.; Gilman Bros. Co., Gilman, Conn.; and Lurie Plastics, Inc., Colonial Heights, Va.

In contrast to conventional methods of *surface* decorating extruded styrene sheet by printing, painting, metallizing, or other secondary finishing operations, the decorative pattern in the new materials is applied as part of the sheet manufacturing operation, it becomes an integral and permanent part of the sheet, and it is located *below* the surface of the finished sheet.

Exactly what method is being used by which company to produce this effect is still shrouded in mystery. It is generally accepted in the industry, however, that the majority of production methods being used are variations on laminating techniques originally developed for turning out high-gloss styrene sheet for the refrigerator market. This consists basically of laminating (using heat and pressure) a thin (about 2 mils), glossy, transparent plastic sheet (preprinted on one side) to the face of the high-impact styrene sheet as it emerges from the extruder. Lamination of the transparent overlay to the freshly extruded alloy sheet can be done on a continuous basis. One company, Kal Plastics, Inc., Beaverton, Mich., has even developed equipment for continuously vacuum forming the decorated sheet immediately after the lamination process. The preprinted side of the



Typical patterns available in decorated styrene sheets. (Illustrations, GATX)

High-impact styrene sheet in mahogany wood-grain pattern holds considerable potential as wall covering. Semi-rigid sheets can be applied easily with common mastic-type cement. (Photo, Chicago Molded Products)

transparent overlay is laminated to the face of the high-impact styrene sheet. Because of the transparency of the film, the finished effect is that of a surface decoration.

Overlay sheets

At the present time, most suppliers seem to be using transparent Polyflex biaxially oriented styrene sheet as the overlay material. The oriented styrene bonds easily and permanently to the opaque high-impact styrene base. It has excellent dimensional stability and clarity, with high gloss and rigidity, and it is relatively low in cost. A number of special ink formulations have been developed which have an affinity to the overlay material and will bond to the base sheet under normal laminating conditions.

More recently, the laminator-extruders supplying the new decorative materials have been working with other types of overlay sheets. General American Transportation Corp., for example, while not disclosing the formulation of the overlay sheet it uses, emphasizes that the sheet has been specially compounded to provide superior resistance to abrasion, ultraviolet light, and humidity, as well as outstanding printing reproduction.

Considerable interest has also been expressed in decorating high-impact styrene sheet by using Mylar polyester film as the overlay material. Both Campco Div., Chicago Molded Products, and Gilman Bros. are currently working on the project. The problems are many, but both companies feel confident that they will soon be overcome and that the decorative Mylar-styrene laminate will open still other new market possibilities, particularly where abrasion and scratch resistance (e.g. furniture) or resistance to grease and oil (e.g. automotive), are fundamental requirements.

Decorative patterns

Any pattern or design that can be photographed can be reproduced in decorative styrene sheet. Samples of well over 50 different patterns, ranging from wood and marble grains to fabric textures and geometric forms, are already being shown by various suppliers. When forming these patterned sheets, even to deep draws, there is hardly any noticeable distortion in the pattern.

A number of suppliers are turning out laminates in which such decorative fillers as fibers or metallic glitter are being used. Also, by

changing the color of the base sheet and by varying the color and translucency of the inks on the overlay, an infinite range of color variations is possible.

Application possibilities

By offering end-users design potential which would be impossible to achieve in a molded product, the decorated styrene sheets have considerably expanded market potentials for sheet materials. These include:

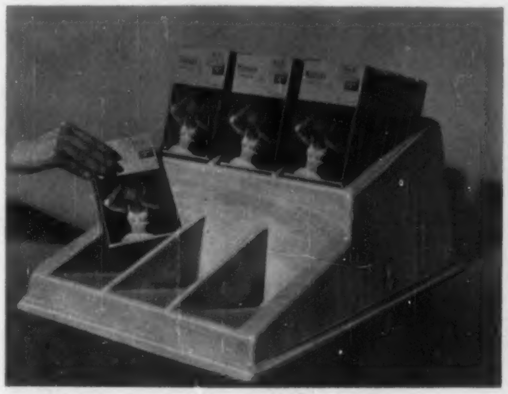
Wall coverings. Once wall coverings based on decorated high-impact styrene sheet materials win acceptance, they can probably, within a few years, account for an amount of styrene equal to the material now going into injection molded wall tile. By adding the decorative appeal to the many other advantages of styrene wall coverings—durability, ease of cleaning, ease of installation—prime outlets for the material are seen not only in kitchen and bathroom, but also in dens and nurseries. In the den or game room, for example, a wood-grain pattern would blend nicely with modern interior decor; in the nursery, decorated styrene sheet incorporating printed scenes from popular nursery rhymes would be a natural. Commercial applications, such as for lounges, restaurants, bars, hotel lobbies, etc., where a luxurious decorative effect is almost a necessity, also hold considerable promise for the sheet materials.

The sheets can be used flat (and applied with common mastic-type cement) or they can be thermoformed into a raised tile pattern or other geometric forms. Because of their rigidity, they cover cracks or other defects in the wall that would show up through thin-gage wallpaper.

Displays. The decorated styrene sheet is also seen to have many excellent applications in the display field—where eye appeal is a predominant requisite.

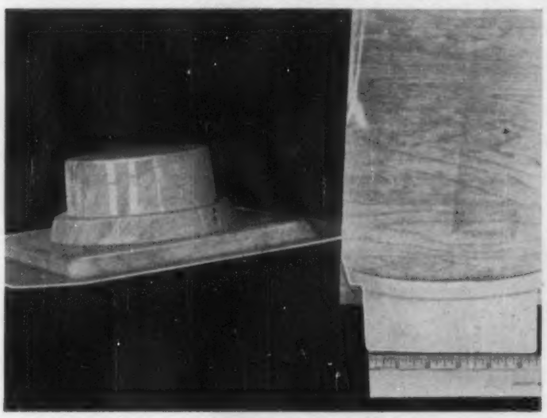
The wood grain patterns, in particular, are especially adaptable to displays. To make a complex part of actual wood requires hours of work by skilled craftsmen; in comparison, the wood grain styrene sheet can be formed over inexpensive molds in a matter of seconds.

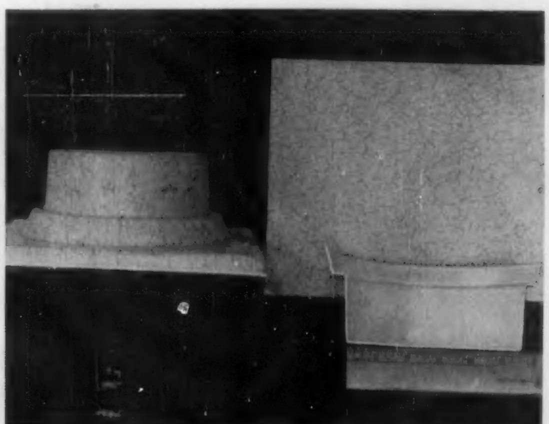
Recent commercial applications of the new



Vacuum formed counter displays also represent major market for decorated styrene sheeting. (Photo, Chicago Molded Products)

Decorated high-impact styrene sheeting can be used in the flat (right) or it can be thermoformed into a contoured shape (left). (Photos, GATX)





Despite depth of draw, distortion in design (wood-grain in photo, left; fibrous pattern, above) is hardly noticeable in formed pieces

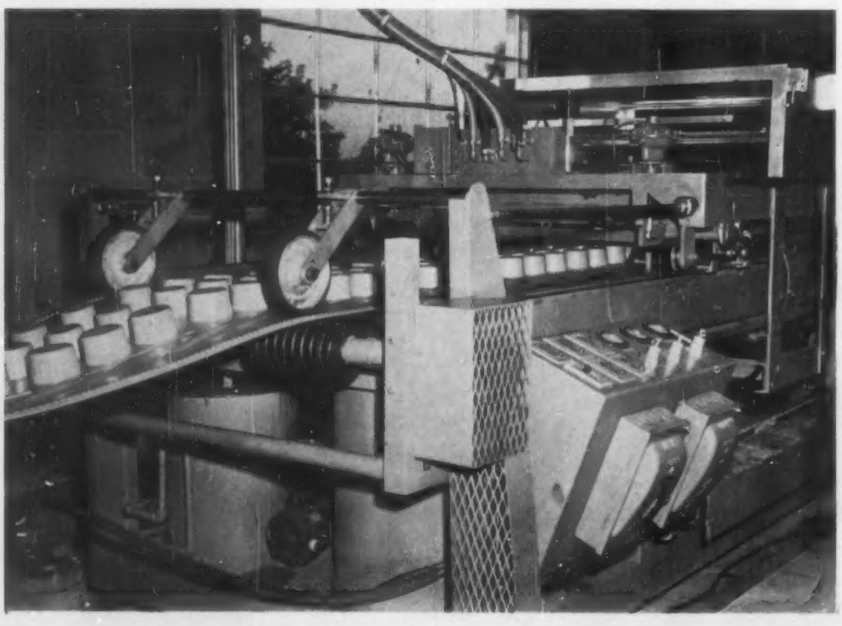
Hull for lightweight model racing boat is formed in one piece of wood grain decorated styrene sheet. (Photo, Chicago Molded)

decorative materials in the display field include: 1) A base for a girdle and pantie display (created by Newhart Products, Devon, Conn., for Warner Bros. Co.) vacuum formed of Campco's high-impact styrene sheet in a driftwood finish; 2) A Calvert Reserve display simulating a framed quotation, formed in one piece, including the frame and the raised letters of the quotation, by Nordic Plastics, Brooklyn, N. Y., using wood grain sheet supplied by Gilman Bros. After forming, the frame and the raised letters are roller painted so that the quotation stands out in sharp contrast against the mahogany wood pattern; 3) A brassiere display form produced by L. A. Darling Co., Coldwater, Mich., using sheet decorated in a black lace pattern by Campco; and 4) A ball-point display case by W. A. Sheaffer Pen Co., formed of gray wood grain sheet. Although this latter formed piece measures 9½ in. high, 19½ in. long, and 9½ in. deep, there is no distortion in the grain pattern.

Refrigerators. As a means of tapping the vast replacement market for refrigerators, manufacturers today are placing emphasis on the job of *annually* improving product design and styling, in much the same way as the automobile industry encourages replacement sales by bringing out new and improved models every year. With the decorated styrene sheet, manufacturers now have the opportunity of taking advantage of a wider range of exclusive patterns to achieve this end in the styling of inner and outer door components, shelves, etc. The ease with which the sheet can be formed on low-cost tooling means important production savings. There is even talk in the industry of building the refrigerator mechanism into the wall of the kitchen; the refrigerator housing would be a removable formed styrene piece (in a decorative pattern) which the housewife could have changed periodically to give a fresh look to her kitchen.

Toys and novelties. In this field, where eye-appeal is so important to merchandising, the decorated sheets should find an excellent outlet. Two examples of such applications—both in

Equipment set-up to continuously form decorated sheet immediately after overlay has been laminated (also continuously) to sheet. (Photo, Kal Plastics)



the hobby boat field—were recently put on the market and have already attracted considerable attention. One, a racing model hydroplane marketed by Lindberg Products, Inc., Skokie, Ill., has a hull vacuum formed of wood grain sheet supplied by Campco; the other, a sailing schooner produced by Flexaplast, Branford, Conn., also has a deck formed of wood grain material supplied by Gilman Bros.

Appliances and furniture. Other applications in other fields equally large in potential sales volume are in prospect. For much the same reasons that the decorated sheets seem so applicable to the refrigerator industry, they should prove useful in the styling of air conditioning units and other appliances. American Reddi Cool, Philadelphia, Pa., for one, recently placed on the market a portable air-conditioning unit completely housed in a case formed from Gilman's wood grain sheet. Clock manufacturers, for example, are sampling the material for clock faces, and reportedly a number of manufacturers of radio, TV, and phonograph sets are experimenting with complete housings, side panels, and component parts formed from the decorated sheeting. Desk and counter tops (using the abrasion-resistant Mylar-styrene laminate), furniture panelling, and formed bureau drawers promise to be excellent applications for the materials in the furniture field. Shower doors, room partitions, and lightweight bathtubs also hold considerable potential for the decorated sheet.

Miscellaneous applications. The automotive industry has expressed interest in panels, dashboards, roofs, etc., formed of the decorated styrene sheeting and backed up with foamed plastics. Marble grain and wood grain bases (backed up with foam) for trophies and desk sets are also possibilities. Emet Vacuum Forming Corp., Brooklyn, N. Y., is forming a frame for the Marsel Mirror Co. of wood grain styrene. In another unusual adaptation, Bernard Edward Co., Chicago, Ill., reports that it is fabricating a peg-board for use in the permanent fixture and in-store display business out of the decorated material. A kittens' comfort pan formed of black styrene sheet with an integral fibrous pattern is also being marketed by Bernard Edward Co.

Lurie Plastics, which supplies decorative sheet with "inlaid" gold fiber and gold and silver particle effects, reports that a lid for a decorative package is being formed of its materials. Other potential applications suggested by Lurie: lamp shades, housewares items such as bowls

Refrigerator door liner formed of styrene sheet in plaid pattern highlights modern emphasis on color in appliances. (Sketch, GATX)

and drain boards, optical products, serving trays, jewelry, and fashion accessories.

Creative possibilities are limitless—and a list of potential end-products based on the decorated styrene sheet could go on and on. Actually, suppliers feel that the infant industry won't start moving for another year or two. Price is still from 5 to 20% higher than non-decorated sheet but most end-users seem to feel that the merchandising advantages to be obtained far outweigh the extra costs. As volume increases, of course, and as production techniques are refined, prices will probably go down—resulting in the opening of newer, larger-volume market areas for decorated high-impact styrene sheet.

Stretched acrylic sheet

For the past ten years it has been recognized that improved properties can be imparted to cast acrylic sheeting by mechanical biaxial stretching. But only in the past three years has much pilot work been done on the subject (see Modern Plastics, *31,* 128, August 1953). At last this material is in production at Swedlow Plastics Co., Los Angeles, Calif., in sheets up to 80 by 80 in. and in thicknesses from ⅛ to ⅝ inch. The first commercial production has been used for Convair F-102 canopies.

Swedlow has not only perfected a biaxial stretching production technique for MIL-P-8184 acrylic sheets but has also developed methods whereby the stretched sheets may be formed and fabricated into parts without significantly reducing the toughness of the stretched sheets.

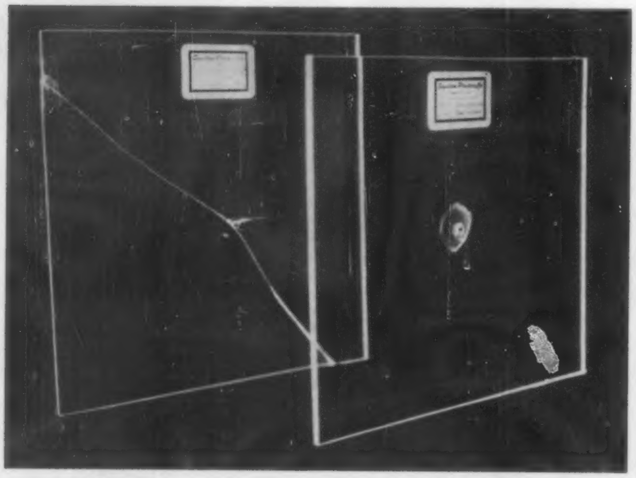
Originally the thought of the technicians was to stretch-form a part to the required percentage of stretch. This idea was abandoned because of the low utilization of expensive material initially stretched. Other approaches were likewise tried and abandoned either because of poor yield or poor properties in the final product. Now the practice is to make a flat mechanically stretched sheet with optical and physical properties predetermined and then to postform those sheets into parts without degrading those properties.

Apparently the two-direction stretching unkinks or uncoils linear molecules and partially orients them parallel to the direction of the stretch. In this development some new terminology has grown up.

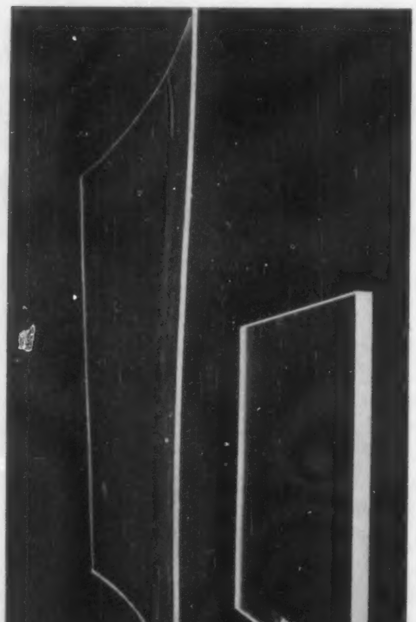
Percent of stretch is defined as:

$$100\left(\sqrt{\frac{T_1}{T_2}}-1\right)$$

where T_1 equals original thickness of sheet and T_2 equals final thickness of sheet. Thus, 100% stretched sheeting has one-quarter the thick-



Correlation between toughness value and shattering is shown when part is gunfired under pressure. Monolithic cast Plexiglas 55 is at left, stretched Plexiglas at right



Plexiglas 55 sheets before and after stretching. The one on the right is material as cast, that on the left stretched sheet. (Photos, Swedlow Plastics Co.)

—a new engineering material

Convair F-102A all-weather supersonic jet interceptor has canopy formed of stretched acrylic sheet; stretching improves impact and craze resistance. (Photo, General Dynamics)

ness and four times the area of the sheet from which it was made. A 75% stretched sheet would have approximately one-third the original thickness, etc.

New testing methods

Inasmuch as "toughness" or resistance to fracturing is not adequately measured by common physical tests, it has been necessary to develop new testing methods. The Naval Research Laboratory test, which measures the amount of work necessary to propagate a fracture, has resulted in the "dw/da" or "toughness value" being accepted as a quality standard for stretched acrylic sheeting.

"As cast" MIL-P-8184 acrylic sheeting has a dw/da of 3.0 to 4.0; "good" stretched sheeting has a minimum dw/da of 20.

The dw/da, or toughness, of a stretched sheet is dependent upon stretching conditions as well as upon the percent of stretch. Because of the wide possible variation in stretching conditions, it is believed that customer requirements for stretched acrylic parts should specify a minimum dw/da requirement rather than percent of stretch. Flat stretched sheeting, postformed by the techniques which have been developed by Swedlow, shows no significant degradation of this toughness value.

Effect on physical properties

1) Stretching improves the *impact strength* and greatly reduces the notch sensitivity of acrylic materials. The extent of this reduction in notch sensitivity is evidenced by the increased dw/da values.

2) *Resistance to both solvent and stress* crazing is greatly improved by biaxial stretching.

3) *Tensile and flexural strengths* and modulus of elasticity are very little affected.

4) Limited test data indicate that *weather* has no more effect than would be expected on the unstretched acrylic sheet. Numerous formed turrets and canopies on production airplanes contain areas which have been stretched as much as 100% at the extreme point of draw. The weathering resistance of the highly stretched section has shown no appreciable difference from the balance of the part.

5) *In water absorption,* the results are about the same as for unstretched materials. The rate of water absorption increases with increase in temperature, as is also true for unstretched materials.

6) *Thermal coefficient of expansion* measured over a wide range of temperature is the same.

7) *The thermal relaxation temperature* of stretched materials is in the same range as the service temperature of materials which are unstretched.

8) The *creep properties* of stretched and unstretched materials are practically the same at low outer fiber stress on cantilever flexure test specimens mounted outdoors. Above 400 p.s.i. outer fiber stress, the creep of stretched materials is significantly lower than for unstretched materials at these loads.

9) *Cementing.* Tests made to date have indicated that the edge attachments on stretched acrylic sheeting may be cemented with the usual completely reactive cements without any degradation in the properties of the stretched material.

Conclusion

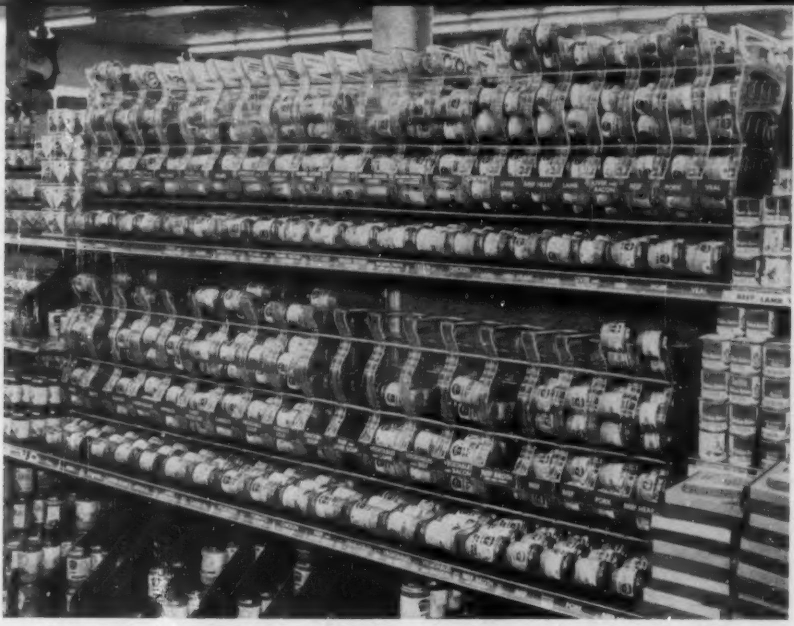
Naturally, the first use of the unique properties of this new engineering material, biaxially stretched acrylic, has been to provide shatter resistance to aircraft canopies for supersonic flight. It is now possible to make canopies lower in weight than ever before possible with conventional materials.

With dw/da values five to ten fold over unstretched acrylic, and with greatly improved craze resistance, the material is being studied for numerous industrial as well as consumer applications.

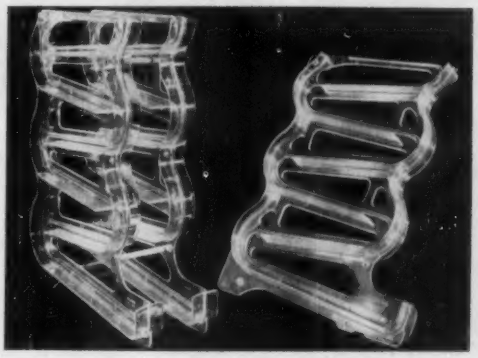
In addition to stretched acrylic sheeting currently available, Swedlow has also made much progress in stretching of polymethyl alphachloro acrylate. Stretched PMACA combines shatter resistance with the high heat resistance for plastic glazing required on speed aircraft.

Stretched acrylic sheet is easily drilled. The procedure is the same as used for unstretched cast acrylic. (Photos, Swedlow)

Cementing edge attachments to cast acrylic sheet is performed in the same manner as with unstretched cast material.



Display rack, which doubles as dispensing unit, is made up of styrene panels with molded-in "tracks" along which the jars of baby food can roll



Transparent styrene panels (far right) are joined together with metal spacer bars (right) to make any required size display. (Photos, Erie Resistor)

Molded styrene vendor *improves display, provides self-service for jars of baby food*

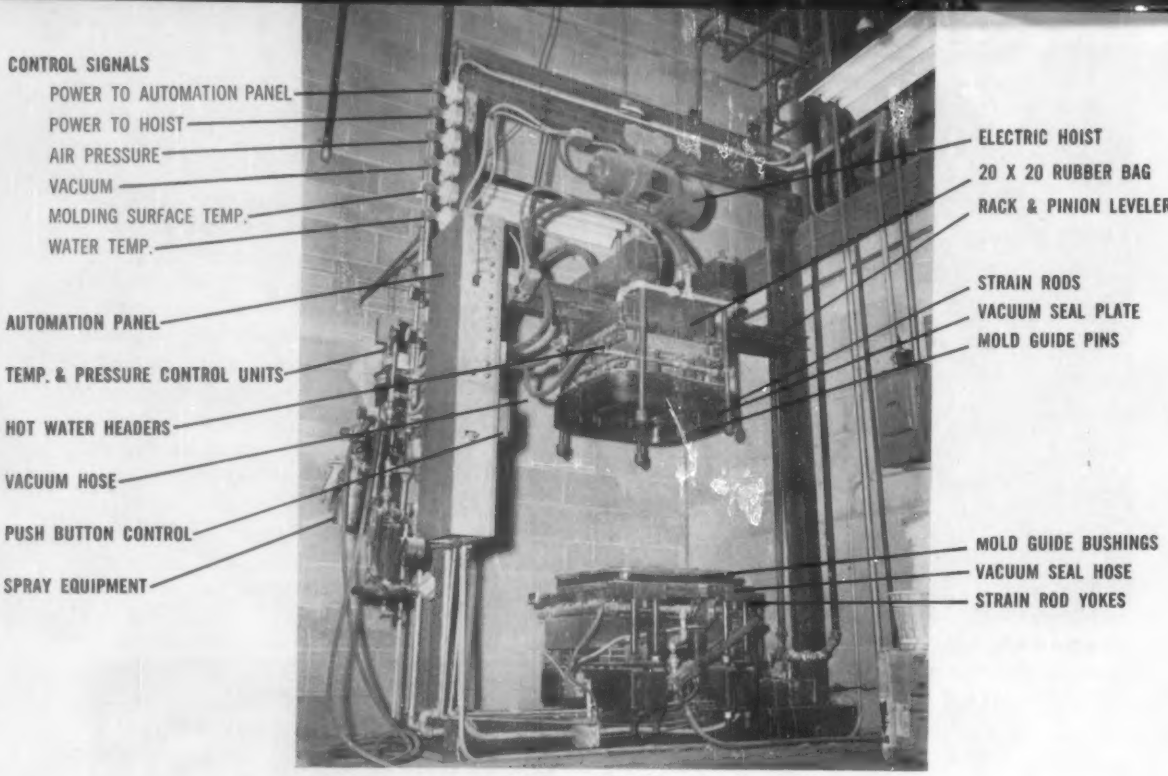
Both display and dispensing functions have been effectively combined in a self-service rack now being molded of crystal-clear general-purpose styrene.

Used for merchandising H. J. Heinz Co.'s strained baby foods, the rack is made up of a number of styrene panels with molded-in "tracks" on the sides along which the jars can roll. When the first jar in the rack is removed, the second jar rolls down into its place while the other jars advance behind it.

Thus, the rack not only provides a prominent display for the merchandise (the transparency of the styrene permits high visibility even through the sides of the unit), but it insures trouble-free self-service. For the retailer, the rack facilitates automatic stock accounting and, since the stock moves in the order in which it is stacked in the rack, prevents shopworn jars from accumulating.

Panels are molded in a two-cavity mold in a 60-oz. Watson-Stillman machine equipped with a preplasticator. The molded-in "track" is duplicated on both sides of the panel so that a single panel can serve as the reverse sides of adjoining compartments. Any number of panels can be joined together by means of metal spacer bars.

Credit: Display rack is molded by Erie Plastics Div., Erie Resistor Corp., Erie, Pa.



Over-all view of 20- by 20-in. pilot press developed for a new method of molding large reinforced plastics pieces on production basis. (Photo, Sterling Precision Corp.)

New press, new process for BIG reinforced

Out of a multitude of problems connected with bag molding (see Modern Plastics *31*, 84, Feb. 1954) and with matched steel die molding of bathtubs, and out of two years of development work, has come a new concept based upon a combination of tool design, tool engineering, and press design and construction which is now swinging into fast production at Sterling Precision Corp.'s Fiber Glass Plastics Div. in Toledo, Ohio.

In over 8000 bathtubs manufactured by the previous methods the following production problems were encountered which, if not overcome, would have forced the product to be priced out of the market.

In hand lay-up bag molding:

a) High degree of operator skill is required to insure accuracy.

b) Difficulty of controlling part thickness as well as cure time on rapid production schedule.

c) The difficulty of obtaining shiny mold surface on any but steel dies.

d) The uncontrolled occurrence of voids back of the mold-coat.

e) Mold-coat accelerator required, with attendant short pot life, for spraying unheated molds, or the use of a catalyst gun with proportioning difficulties.

f) Yellowing with age of highly accelerated mold-coat mixtures.

In matched steel die molding:

a) The high cost of dies and presses. (Several sizes and right and left hand models are necessary.)

b) The impracticability of getting required part-thickness accuracy in large steel dies.

c) The need for cycling die surface temperature for the mold-coat application.

d) The uncontrolled occurrence of voids back of the mold-coat.

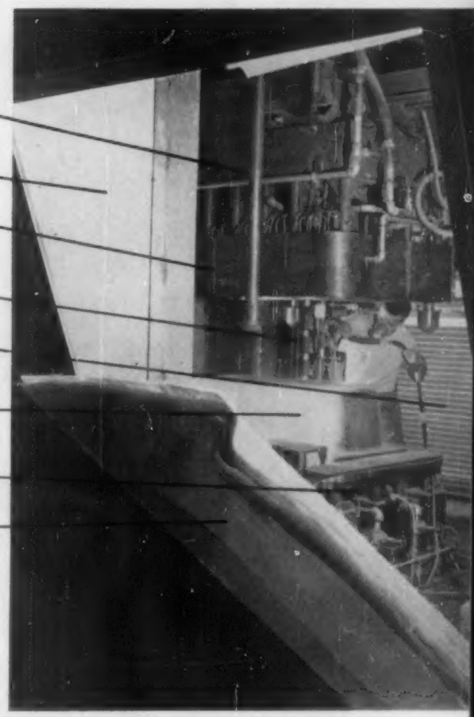
e) The difficulty of controlling the glass content in the preform over areas of different part thickness.

f) The need for cleanliness and positive ventilation in the press area.

Three main purposes were involved in the development of the new method. First, the idea of producing tools from materials of different coefficients of thermal expansion to obtain great accuracy at elevated working temperatures; second, to place and work the material at a low temperature and under no pressure and then to achieve the proper heat and high pressure quickly; third, to produce a vacuum on the molding material at time of press closing in order to make dense and void-free pieces over the various section thicknesses which are required.

Mold construction

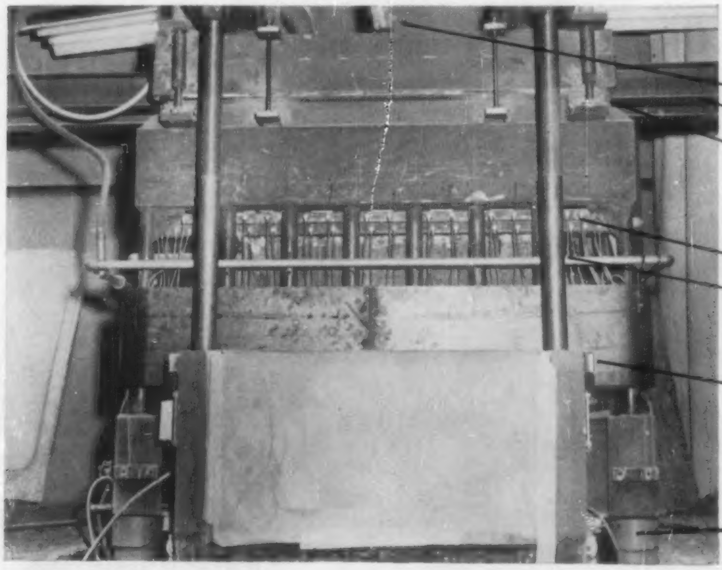
The result of work done by Sterling, assisted by Wayne Engineering Research Institute (Wayne University) is a press construction and a mold making method that appears now to be adaptable to pieces much bigger than bathtubs—for instance, to garage doors, to boats, and to automobile bodies. Further refinements are now on the drawing board which

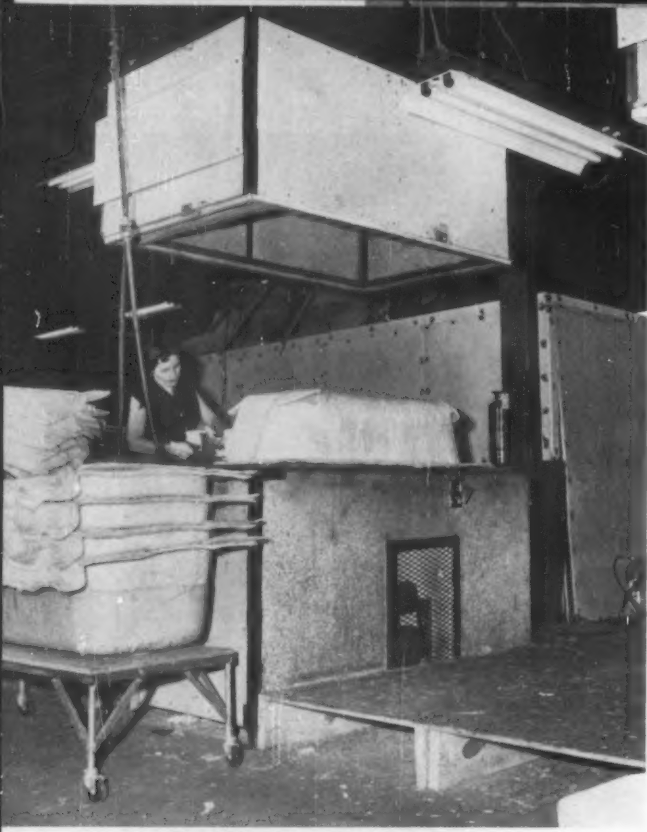


Preform delivery door (here in open position to show details of the mechanism) is located at back of production press. (Photo, Sterling Precision Corp.)

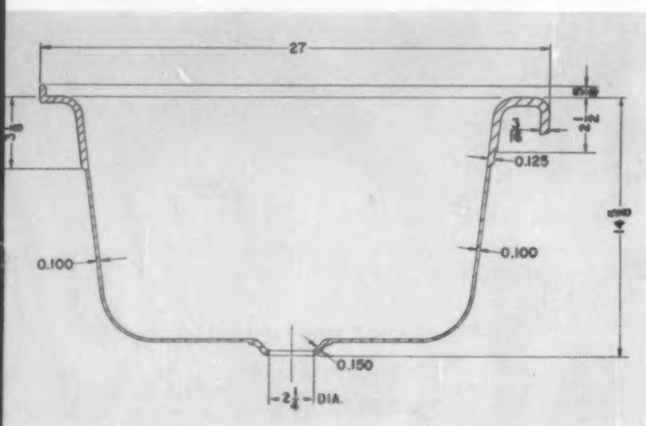
plastics pieces

Front view of production press, showing major components. No guide rods are used since dies are readily aligned at working temperatures. (Photo, Sterling Precision Corp.)





Bathtub preform being tailored; oven hood is above. Preform table becomes curing oven when hood is lowered and heat turned on



Cross-sectional sketch of 54-in. reinforced plastics bathtub, showing the different thicknesses of the various sections

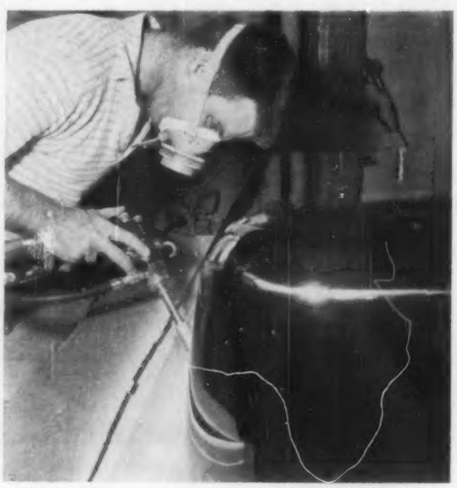
should permit the molding of composite sandwich structures of various kinds.

The surface of the male mold, which goes on the lower platen of the press, is merely a skin of 16-gage stainless steel sheet wired to become its own electrical-resistance heater. This skin is so thin that its temperature can be raised or lowered between 170 and 240° F. in 15 seconds. The energy is provided by a current of 25,000 amp. at 2 v., from a welding transformer; to obtain a maximum of 10° difference of heat variation over 22 sq. ft. of mold surface, "shunts" are soldered to the back of the stainless steel skin. Against this current bypass system on the under surface of the male die is cast a ¼-in. layer of synthetic elastomer to provide insulation and allow for differential contraction and expansion between the mold surface and the supporting structure. Then the supporting structure—an epoxy filled 50% with aluminum powder—is cast against the elastomer while heated to 200° F. by an embedded water circulatory system of copper tubing. This epoxy sub-structure is in turn supported by structural steel.

The female die is made by casting filled epoxy over a high-temperature wax lay-up on the steel surface in two steps. The initial casting is ¼ in. back from the steel surface; then the face is a tie-in casting made by bringing the whole female tool up to mold working temperature by means of copper tubes embedded and soldered to heavy copper screen.

This means, of course, that when the tools made of dissimilar materials are cold, they will not close; but when they are at working temperature, they are exact to within ±0.005 in. over the whole 22 sq. feet.

To make the dies self-aligning upon closure,



Special spray gun is used to deposit gel coat into lip area of stainless steel male die before preform is positioned

steel bushings are cast into the base of the male die vertical to a surface plate. This is done with the die at working temperature. Pins with 0.001-in. tolerance to the inside diameter of bushings are placed in the bushings. The surface plate of the female die has a large hole for each of these pins and, again at working temperature, the female structure is lowered and the pins are cast into it. When the die is cool, this alignment can be as much as 0.05 in. out, but when brought to heat it is most exact.

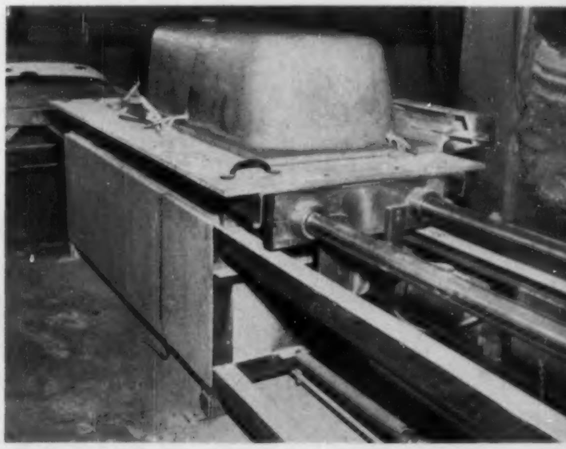
The press and the method

With the dies so readily aligned at working temperature, no guide rods are used on the press. Thus, "daylight" is limited only by the height of ceiling. The female die is raised or lowered by an electric hoist, and sleeves (either spring- or air-pressure-actuated) in the steel bushings in the male mold hold the female separate from it upon lowering. When this happens, a vinyl tube around the edge of the male die is blown up and seals the molding material within the space between the dies. At this point a 22-in. vacuum is pulled for 8 sec. on the material, in which time the styrene begins to boil out. The vacuum is automatically tripped off and a rubber bag at the head of the press above the female is expanded, providing the power stroke while at the same time the die heat is raised from 170 to 240° F.

The working press, which weighs approximately 4 tons, is made of structural iron without close tolerances but is completely automatic with push button controls. The press with a 40- by 60-in. platen is rated at 120 tons since the inflated rubber bag provides a power stroke of 240,000 p.s.i. When the press has finally closed, strain rods go through holes in yokes at the four corners of the press and are automatically held until the end of the cycle. *(To page 228)*

Special jig fixture is used to cast an isocyanate foam on the tub base to make level installation easier and provide resiliency

Polyester resin is poured on preform placed in position on male die. A special pouring jig is used in this operation. (Photos, Sterling Precision Corp.)



Molded bathtub is placed on a trimming saw which is preset for trimming the lip at right angles to the material

Revolutionary railroad passenger car achieves great saving in weight, with safety, and features an

"All-plastics" interior

Within the past five years, intensified demand for low operating and maintenance costs in public transportation facilities has pushed plastics into the limelight as prime materials of construction. In the design of railway passenger cars, in particular, the trend has started to gain momentum at a phenomenal rate—with nearly every major manufacturer announcing plans for lightweight, low-silhouette trains making an extensive use of plastics materials (see "Plastics applications in the years ahead: transportation," MODERN PLASTICS 33, 166, June 1956).

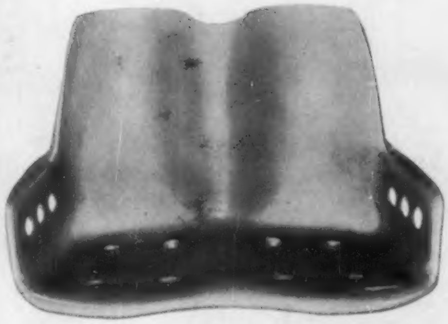
Latest entry—and probably one of the most important from the standpoint of plastics usage—is the revolutionary "Pioneer III" passenger car developed by The Budd Co., Philadelphia, Pa. Featuring an all-plastics interior (based primarily on polyester-glass laminate materials), the car is intended to serve as the basic unit of a train most suitable for commuter service or middle-distance runs, on which it is not feasible to develop the daily mileages necessary to support the operating cost of standard present-day railway equipment.

To achieve this end, Budd has concentrated on reducing the weight of the car (thereby increasing passenger capacity) and on keeping maintenance costs at a minimum—and in both areas, plastics materials have made a major contribution to the success scored by Budd.

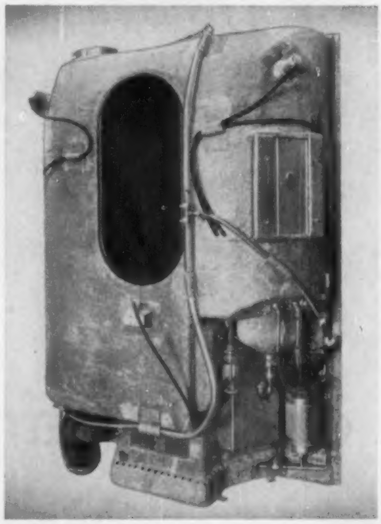
From the one-piece molded reinforced plastics stairwell at the front of the car to the one-piece reinforced plastics bathroom unit at the rear, the entire interior is in plastics.

At each bay in the coach section of the car,

By adapting plastics to use in seating, flooring, wall panels, lighting, and accessory interior equipment in new railway passenger car, weight and costs of maintenance are reduced



One-piece double seat shell (right) and wall paneling (above) are both molded of reinforced plastics. Seats are cushioned with vinyl foam

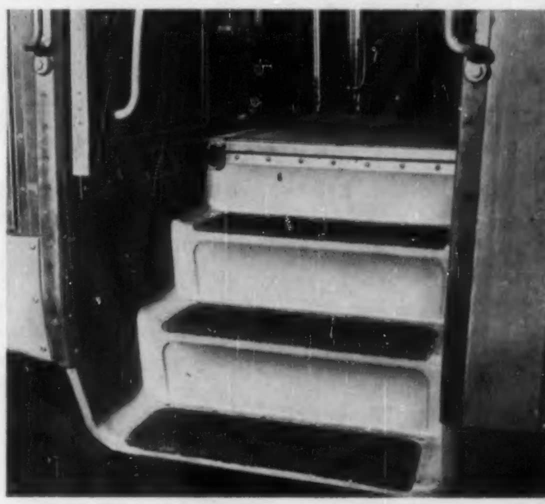


Reinforced plastics lavatory (left), also molded in one piece (including walls, sink, and toilet), is prepiped and prewired (back view, above) before being mounted into car

a single reinforced plastics panel, which forms the lower portion of the baggage rack and which incorporates a molded-in opening to accommodate the window, extends down from the heater guard. A second reinforced plastics panel on top of this one combines the upper portion of the baggage rack, the ceiling, and half of the air duct. Panels in adjacent bays are connected with a single extruded aluminum molding.

In common with the other reinforced plastics components in the "Pioneer III," color is integral with the panels and no painting is necessary. The hard wearing surface will also resist scuffing during normal service for a long time; however should any repairs be *(To page* 230)

Stairwell is another unit molded in one piece of reinforced plastics to reduce assembly and maintenance costs. (Photos, The Budd Co. and Owens-Corning)



Polyethylene film is used as strawberry mulch on the Ishibashi Bros. ranch in Calif. One end of the film roll is buried at the head of a row of plants and the roll attached to a jig in back of a tractor. The tractor unrolls the film over the plants. After workers have tucked in the film, they cut small holes in it with razor blades and pull the leaves through the holes. (Photo, Bakelite)

Film on the farm

Mulching, conservation of irrigation water, and protection of silage with polyethylene and vinyl film all mean more money in the farmers' pockets and vast new potential markets for plastics films

What's the price of polyethylene by the acre? That question is the tip-off to a significant new market for plastics films on the farm. To provide answers for their new farm customers, extruders of polyethylene film and sheeting have had to start thinking in unfamiliar terms: mulches, acre-feet, even square-mile price quotations instead of cents per pound.

And what's been happening back on the farm? For the past three or four years, farmers and agricultural scientists have been quietly experimenting with low-cost, flexible plastics films.

Potentially the most important use for polyethylene film is as a mulch for row crops, (crops that are planted, not sown like wheat or grasses). Mulching is an ancient farm practice that is conventionally employed to keep the soil around plants soft and moist, to curtail the growth of weeds, and to prevent the disease and rot that occur when fruit comes in contact with moist ground. Peat moss, buckwheat hulls, salt straw, sawdust, and even newspaper have been used as mulches, with limited success.

Polyethylene film economically and efficiently performs all the functions of a mulch and more. It is an excellent moisture vapor barrier that prevents evaporation of soil moisture. At

Agricultural Film Potentials

According to Dr. C. E. Staff, Bakelite Co., a Div. of Union Carbide and Carbon Corp., an estimated total of between 200,000 and 300,000 lb. of polyethylene and vinyl resins will be used in the production of film for agricultural purposes during 1956. Dr. Staff further estimates that in less than 10 years this figure will hit 100 million lb.—and he rates this estimate as conservative.

Details of agricultural plastics film uses are given in the accompanying article. At present, greenhouses, strawberry mulching, and tomato covers are the major commercial applications. Work at Agricultural Experiment Stations indicates that many other truck-farm operations can profitably use a polyethylene film mulch, especially where farming is intensive.

With low-cost row covers and greenhouses it may become practical to raise vegetables all year round near our northern cities. The saving on transportation could be balanced against the cost of the film. Dr. Staff states that this equation has been worked out by flower growers, but that no commercial vegetable grower has tried it yet. The field is wide open.

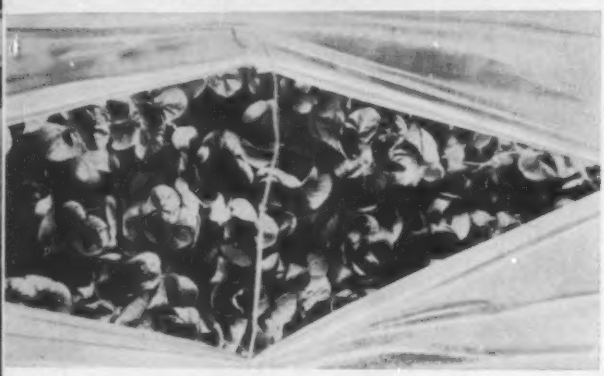
the same time it keeps the soil from being compacted by driving rain, or baked hard by noonday heat. Black or opaque films cut off light and stop the growth of weeds. Crops grow up through slits cut in the film for them and mature quickly without having to compete for light and air. Tomatoes, strawberries, and other plants that fruit above ground can rest their fruit on the soft, smooth film without harm.

Moreover, polyethylene film offers many other properties that conventional mulches do not have. If care is taken in installation, the film mulch can last through several plantings. There is reason to believe that nitrogenation increases under the plastic mulch. And there is an insulation or blanket effect which raises the temperature of the soil under the mulch several degrees above that of unmulched soil. This ability to store heat helps to bring crops to early maturity, especially in the spring.

Success with strawberries

Crops mulched with polyethylene film have increased their yield by as much as 50 percent. As an example, take the experience of the Ishibashi brothers in Torrance, Calif. Fruit losses due to mold rot had driven them to the point of no return from their 12-acre strawberry farm. As a last despairing measure a few years ago they decided to try a mulch of polyethylene

Greenhouse made of polyethylene film on simple wood frame can be built at 1/6 to 1/20 the cost of conventional glass houses. The film, 0.002 in. thick, is installed over 2- by 4-in. wooden members by tacking it with wooden lath. Greenhouse improves out-of-season crop yield. (Photo, Bakelite Co.)



Growing season for lettuce and tomatoes can be extended with the use of polyethylene film row covers. The film is installed over wire wickets. For ventilation, slits are cut along the top and held open by a notched wire wicket. (Photo, Bakelite)

film to keep the berries from rotting on damp soil. Their harvest in April and May 1955 increased by roughly one third. They were able to supply 10% of the Los Angeles market in the season when consumers were paying premium prices for strawberries. And this from about 0.1% of the total commercial berry-growing acreage serving the market. The polyethylene film mulch reduced their fruit losses due to mold rot by 75 to 85 percent.

One of the great values of plastics is their easy adaptability to new techniques and different circumstances. The strawberry growers in California used a clear film over ground that had previously been treated with weed killer. Slits were cut in the film through which to pull the foliage of the young plants, after the film mulch had been laid over the rows from a roll attached to the back of a tractor. The film was supplied with special perforations for this job. Along the outer edges were ½-in. holes to allow free passage of irrigation water; down the middle of the web were ⅛-in. holes to drain off rain water or accumulations of dew.

In Kentucky, however, vegetable growers came up with a different planting technique employing black-pigmented polyethylene film. The film is spread over slightly furrowed ground and seeds are planted with a corn-planting mechanism which slits the film. The young plants sprout up through the slits. Using black film, it was found, did away with the need for chemical weed killers. Without light, weeds sprouting beneath the black film got nowhere while the seed crop flourished above the film blanket.

At the Agricultural Experiment Station of the University of Kentucky, Dr. E. M. Emmert tried a number of different types of film and film colors on a series of small plots. Black film made from specially formulated polyethylene, he found, worked especially well for early spring and late fall plantings. Apparently the black pigment can absorb enough heat from the weak sunlight in those months to keep plants warm and encourage plant growth. In

Perforated polyethylene film is used to protect late ripening tomato plants from effects of adverse weather. To reduce the amount of moisture condensation inside the covers, aerating holes are punched in film (below) at regular intervals. (Photo, Bakelite Co.)

Watertight tarpaulin for lining irrigation and stock watering ponds to prevent water loss from seepage is produced by heat-sealing together strips of vinyl film. Liner is installed by unrolling the tarpaulin over bare ground on bottom and sides of scooped-out area. In experimental installation shown at right, water level has remained fairly constant. (Photo, Bakelite)

midsummer, when the sun beats down from directly overhead, an aluminum pigmented film brings the best results. The film reflects heat and keeps the temperature beneath the film from rising too high.

Greenhouses, too

By using 0.0015- and 0.002-in. polyethylene film, Dr. Emmert has shown that it is possible to construct greenhouses with simple wood frames at anywhere from one-sixth to one-twentieth the cost of conventional glass houses; and these plastic greenhouses cost about half as much to heat. For more than eight years he has been harvesting several commercial crops per year under the plastic greenhouses. Two years of controlled scientific tests indicate that certain vegetable and flower crops can be grown at less cost under plastic than under glass.

The use of plastic film reduces the construction of greenhouses to simple essentials. Inexpensive rough lumber is used for uprights, rafters, and beams; rough lath tacks the film to the frame. Dr. Emmert uses film 0.002 in. thick to cover the outside, film 0.0015 in. thick on the inside. This double layer of film creates a dead-air space for insulation that cuts heating costs by as much as 50 percent. The cost to build one of these plastic greenhouses in Lexington, Ky., a structure 18 ft. wide by 84 ft. long, came to about $200, excluding labor. The materials cost broke down into $50 for polyethylene film, and $150 for lumber. For a glass structure of the same size, the cost of materials, at present prices, is estimated at about $4000. Labor costs for the plastic greenhouse are also low because of the simplicity of the structure and the ease of handling the plastic film.

Tomatoes were grown in the spring of 1955 under carefully controlled conditions in both a plastic and a glass greenhouse. Dr. Emmert's records show that the tomatoes raised in the plastic house yielded about ½ lb. more per plant and were of better quality. Lettuce, beans, eggplant, peppers, beets, cabbage, and several varieties of flowers also grew well under plastic. Dr. Emmert accounts for the superior plant growth by the greater moisture retention and lower heat loss at night in the plastic film greenhouse. The heat of the sun

during the day, however, does not build up as much inside the plastic greenhouse as it does under glass. Each film is approximately equivalent to glass in transmitting sunlight.

Hail, sleet, rain, or snow have little or no effect on the film. But by the end of summer, harsh sunlight and year-through weathering have taken their toll. September, Dr. Emmert feels, is about the best time for replacing the film on the greenhouse each year. This replacement cost is remarkably small when set beside the high initial cost and annual upkeep of a glass house.

As an example, a plastic greenhouse 8 ft. wide and 120 ft. long was built last year in Wantagh, Long Island, N.Y., for the Mill Road Greenhouses at an approximate cost of $500 for labor and materials. Film replacement is estimated to be at most about $150 per year. About $3000 would be needed to cover labor and the glass, cinder block, and metal construction of a conventional greenhouse of the same size. Neglecting the considerable maintenance costs of a glass house, it would take nearly 18 years of annual film replacement for this cost to equal the initial expense of the glass house.

The light weight and flexibility of film made from polyethylene are major factors in cutting down labor costs for greenhouse construction. A total of about 150 man-hours went into the installation for Mill Road Greenhouses. Two men handled the job between them and finished it in 10 working days.

And miniature greenhouses

The ease of handling polyethylene film, its low cost, and its many useful properties seem to have stimulated the natural ingenuity of the farmer and farm scientist. Experiments with plastic films applied to age-old problems began to spring up several years ago in odd places across the country. After his success with the plastic greenhouse, Dr. Emmert went one step further. He saw no reason why the long rolls of plastic film could not be stretched directly over crop rows in the fields. This amounted to making miniature, portable greenhouses wherever the plants were grown.

To support the film over row crops growing in fields, wire hoops similar to croquet wickets are spaced about every 2½ ft. along the row. The film width is wider than (*To page* 233)

Winter feed for animals can be stored in spots around farm in vinyl silos which consist of open-ended film sleeves that can hold up to 70 tons of silage. (Photos, Bakelite Co.)

Winter-feed losses in conventional silos are reduced by vinyl cap (shown being tied at left) to about a bushel, compared with earlier losses of from 6 to 8 tons per silo

AUSTRALIA: great growth in past decade

*By K. E. Von Wolff**

The Australian Plastics Industry dates from 1917, when one small company in Sydney began to manufacture items from phenol-formaldehyde. Growth from this humble beginning was slow, but steady, up until the outbreak of World War II.

The industry expanded during the war and in 1946 there were 107 factories employing 3500 persons and producing articles to the value of £2,694,000. At that time, phenol-formaldehyde powders were almost the only plastic material made in Australia and all other requirements were imported.

*Managing Editor, "Australian Plastics Journal"

Presented here is the eighth article in the series "Wide World of Plastics" which started in our May issue.

These authoritative articles are written by plastics publication editors or industry leaders. The purpose of the series is to show the progress of plastics throughout the world.

In each succeeding issue, countries not checked in the list at the right will be represented.

- **Argentina** ✓
- **Australia** ✓
- **Belgium** ✓
- **Brazil**
- **Canada**
- **Denmark**
- **France** ✓
- **Germany (West)**
- **Great Britain** ✓
- **Holland** ✓
- **India**
- **Israel** ✓
- **Italy** ✓
- **Japan** ✓
- **Luxemburg** ✓
- **Mexico**
- **New Zealand**
- **Norway**
- **South Africa**
- **Spain**
- **Sweden**
- **Turkey**

✓ Covered in this issue

✓ In previous issues

Since 1946, plastics growth has been at a much accelerated rate. Today there are some 250 molding and fabricating plants employing approximately 6600 persons and producing molded articles to the value of almost £20,000,000 per annum.

All types of plastic moldings and articles are now produced in Australia, and almost all processes used overseas are practiced.

Materials

Keeping pace with this growth in the molding and fabricating side of the industry, is a continuously expanding raw materials production.

Almost each year sees the establishment in Australia of further productive capacity for established materials and the start of manfacturing facilities for turning out plastic materials previously imported.

Prior to 1945, the only plastic molding material made in Australia was phenol-formaldehyde. Today, the range of materials made in Australia includes phenol-formaldehyde, urea-formaldehyde, melamine-formaldehyde, cellulose acetate, polystyrene, polyvinyl chloride, polyesters, and casein. A large range of resins for surface coatings, laminating, shell molding, textile treating and coating is made. Polyvinyl acetate and polystyrene emulsions are also produced. Plasticizers of the phthalate and phosphate type are presently being made in large quantities.

In 1945-6 the production of amino plastics began in Australia and capacity was increased

Australian production of plastics molding powders

Material	*Manufacturer*	*Estimated annual production, lb.*
Urea formaldehyde	I.C.I.A.N.Z. Ltd. Beetle-Elliott Ltd.	3,600,000
Phenol formaldehyde	Monsanto Chemicals (Aust.) Ltd. Beetle-Elliott Ltd. Tonwell Pty. Ltd.	6,220,000
Melamine formaldehyde	Beetle-Elliott Ltd.	240,000-2,400,000 (depending on military contracts for tableware)
Polystyrene	Monsanto Chemicals (Aust.) Ltd. C.S.R. Chemicals Pty. Ltd.	108,000,000
Polyvinyl chloride	I.C.I.A.N.Z. Ltd.	120,000,000-144,000,000
Cellulose acetate	C.S.R. Chemicals Pty. Ltd.	12,000,000
Polyvinyl acetate	Beetle-Elliott Ltd. Reichhold Chemicals Inc. (Aust.) Pty. Ltd. Monsanto Chemicals (Aust.) Ltd.	Annual output is unknown but would run to several hundred tons
Polyester resin	Reichhold Chemicals Inc. (Aust.) Pty. Ltd. Polymer Corporation Pty. Ltd. Monsanto Chemicals (Aust.) Ltd..	Annual production to date would probably not exceed 3,600,000 lb., but could rise rapidly if import licensing restrictions were eased
Plasticizers	C.S.R. Chemicals Pty. Ltd. Polymer Corporation Pty. Ltd. Monsanto Chemicals (Aust.) Ltd.	Because of local production, licenses have not been granted for some years for either tricresyl-phosphate or bioctyl phthalate

Company addresses: Beetle-Elliott Ltd., 35 Terry St., Rozelle; C.S.R. Chemicals Pty. Ltd., 9-13 Young St., Sydney N.S.W.; I.C.I.A.N.Z. Ltd., 380 Collins St., C.1.; Monsanto Chemicals (Aust.) Ltd., Somverville Road, Braybrook Vic.; Reichhold Chemical Indus. (Aust.) Ltd., Rothschild Ave., Rosebery N.S.W.; Polymer Corp. Pty. Ltd., Mandemar Ave., Homebush N.S.W.; Tonwell Pty. Ltd., Grosvenor St., Cremorne N.S.W.

substantially in 1948 and 1950. In 1950 also came the first production of polyvinyl acetate emulsions for use in paints.

In 1950 production of polyvinyl chloride began in a plant of 2,000,000 lb. capacity. Australian usage of this material increased so rapidly that this plant was almost too small before it was completed. In 1953 and 1954 capacity was rapidly expanded to over 10,000,000 lb. per year, and a range of both granular and emulsion polymers are now available. High grade electrical polymers as well as products suitable for the preparation of pastes for spreading, flush molding, dip coating, and the manufacture of unsupported vinyl film by calendering, for flooring, and for the extrusion of hose, etc., are manufactured. Other ranges of polymers for the extrusion of rigid pipe and fabrication of rigid sheets are also made.

The first Australian production of cellulose acetate in commercial quantities began in 1953, and acetate capacity is sufficient to more than

satisfy Australia's total reqirements. In November 1953, the first commercial production of polystyrene commenced in Victoria; the initial installed annual capacity of this plant was 6,000,000 pounds. 1955 saw the opening of a second plant for the production of polystyrene, again using imported monomer. This year it was announced that a plant for the production of polyethylene would be built at Botany N.S.W. The cost of establishing this factory will be £2,250,000 and production initially will be based on ethylene obtained from alcohol derived from sugar.

Among the molding materials and plastics used in Australia, but not yet manufactured here, are nylon, acrylics, polyethylene, high impact styrene alloys for sheet manufacture, ethyl cellulose, cellulose acetate butyrate, celluloid, saran, fluorocarbons, and polyurethane. The following raw materials used in resin production are also fully imported: urea, melamine, styrene monomer, and vinyl acetate monomer.

The Australian resin industry has been greatly helped in its gowth by its association with overseas companies. American firms with either subsidiary or associate companies or licensing arrangements for manufacture in Australia are Reichhold Chemicals Inc., Monsanto Chemical Co., Catalin Corp. of America, and American Cyanamid Co. British companies so involved are Imperial Chemical Industries Ltd. and Distillers Co. Ltd.

Exports of plastic materials (including paint resins) are increasing, particularly to New Zealand, and exports for 1954-55 were valued at £588,078 compared with £403,706 for the previous year.

The demand for thermosetting powders is steadier than for most plastics; it has maintained a steadily rising trend and may well continue inceasing at an average annual rate of 5 to 10 percent.

Production capacity is estimated at 10,000 lb. of phenol-formaldehyde and 5,000,000 lb. of urea formaldehyde per annum.

The present capacity for cellulose acetate manufacture greatly exceeds consumption and it is possible that film and sheet manufacture may be undertaken in the near future, thus opening new outlets for this material. The use of acetate in moldings is however also increasing.

Until 1955, the capacity for production of vinyl in Australia was inadequate, but now the position has almost been reached, where all local requirements can be met from local production. It is estimated that consumption of

POLYETHYLENE-LINED RESERVOIR

An earth dam built by the Victorian State Rivers and Water Supply in Australia in 1920 as a reservoir for the city of Charlton was for 35 years a problem—because it would not hold water.

Last year the problem was solved and the dam, with a surface of 1½ acres, 30 ft. deep, and a capacity of 4,500,000 gal., is now holding water.

The answer to the problem was the lining of the dam or reservoir with polyethylene film. First, the soil in the bottom and the sides of the dam were packed down with a road-roller. Then 0.008 in. film was laid directly on the packed soil in strips 72 in. wide, overlapped about 4 in. and joined with a suitable adhesive. It took more than two tons or 6000 yards of polyethylene film to cover the dam. Finally, the film itself was covered with 6 in. of clay.

So 36 years after its first construction, thanks to plastics and Australian ingenuity, the dam is now in service.

Imports into Australia, 1954-1955*

(latest statistics available)

Type of material	*Total*	*Previous Year*
Synthetic resins not processed or processed to a lesser extent than state of blocks, films, rods, sheeting, sheets, strips, tubes, or other preformed shapes, and synthetic resin molding compounds.		
Phenolic	151,169 lb.	489,289 lb.
Amino	1,070,762 lb.	832,312 lb.
Polyvinyl chloride	6,607,823 lb.	
Polyvinyl chloride copolymers	1,324,854 lb.	
Polyvinyl acetate	505,028 lb.	
Acrylic	259,130 lb.	207,774 lb.
Polystyrene	7,633,184 lb.	8,414,828 lb.
Polyethylene	2,680,280 lb.	
Synthetic resins processed to the state of, but not further than, blocks, films, rods, sheeting, sheets, strips, tubes, or other preformed shapes.		
Phenolic	195,162 lb.	72,600 lb.
Amino	7,463 lb.	600 lb.
Vinyl or vinylidene in any polymerized or copolymerized form	974,945 lb.	241,489 lb.
Acylic	1,727,099 lb.	
Polystyrene	41,037 lb.	
Polyethylene	21,844 lb.	
Films, sheeting, or sheets supported with textile fabric; films, sheeting, or sheets which have been printed, polished, or embossed, or subjected to any combination of these processes; coated textile fabrics including leathercloth and imitation oil baize produced from or prepared with synthetic resin.		
Phenolic	3,758 sq. yd.	55,986 sq. yd.
Vinyl or vinylidene	2,617,567 sq. yd.	1,905,114 sq. yd.
Acrylic	146 sq. yd.	
Polyethylene	12,949 sq. qd.	
Cellulose acetate or cellulose acetate butyrate not processed or processed to a lesser extent than the state of blocks, films, rods, sheeting, sheets, strips, tubes, or other preformed shapes and molding compounds of the cellulose acetate or the cellulose acetate butyrate type.	479,071 lb.	521,280 lb.
Cellulose acetate or cellulose acetate butyrate processed to the state of, but not further than, blocks, films (when not suitable for use as a wrapping paper), rods, sheeting, sheets, strips, tubes, or other preformed shapes.	696,332 lb.	561,971 lb.
Cellulose acetate or cellulose acetate butyrate films, sheeting, or sheets supported with textile fabric; films, sheeting, or sheets which have been printed, polished, or embossed, or subjected to any combination of these processes; coated textile fabrics including leathercloth and imitation oil baize, produced from or prepared with cellulose acetate or cellulose acetate butyrate.	26,500 sq. yd.	3,815 sq. yd.

*Countries of origin of imports: U. K., U.S.A., Holland, Italy, France, Japan, Norway, Sweden, Canada, Switzerland.

vinyl will continue to increase at a rate of 10 to 12½% per year.

The following figures show some quantities of *molding materials* used in 1953-54; figures for 1955 are estimates only and the statistics for previous years are not comparable as collection then was on a different basis.

Material	*Year 1953-54* *Usage, lb.*	*Year 1955* *Usage, lb.*
Melamine formaldehyde	200,700	
Phenol formaldehyde	5,900,000	6,000,000
Urea formaldehyde	3,123,300	3,600,000
Cellulose acetate	942,800	1,000,000
Cellulose acetate sheet	800,000	1,000,000
Polystyrene and copolymer	6,027,500	
Polyvinyl chloride	3,653,400	8,000,000

Equipment and machinery

Side by side with the developments in materials has been a sound growth in machine building. The Australian engineering industry produces compression presses of all sizes and types, fully automatic injection molding machines up to 60 oz. in capacity, extruders, heat sealing machines, high frequency heating equipment, scrap grinders and pumps, and a full range of auxiliary equipment. These machines are fully up to date and incorporate the latest overseas improvements and innovations.

Die and tool making is a well established industry and the products compare very favorably with overseas tools. In these fields, as in the field of plastics materials, there has been valuable association with American companies including Cumberland Engineering Co., Inc., Standard Tool Co., Hydraulic Press Mfg. Co., John Waldron Corp., and National Rubber Machinery Co.

Plastics products

There are less than 10 million people in Australia, a country approximately equal in area to the U. S. A., yet a wide range of plastics products is made.

Semi-finished products include decorative laminates, industrial laminates, plastic rod, shapes, and tubing, polyethylene piping, styrene sheets, vinyl belting, flooring materials, calendered film, layflat tubing, coated fabrics, reinforced plastics and various fabricated acrylic signs.

American companies associated with the production and fabrication of such products in Australia include: Visking Corp., Joseph T. Ryerson & Son, Inc., St. Regis Paper Co., Plexon Inc., Lunn Laminates Inc., John V. Davis Inc., and Alsynite Co. of America. A British firm likewise associated is Jarrett Rainsford & Laughton; another British firm, Thomas De La Rue & Co. Ltd., has recently announced the formation of an Australian associated company, with a capital of £500,000 to produce Formica laminates.

Reinforced plastics

Low pressure moldings and laminates, previously neglected in Australia are now coming more into favor. Large moldings including car bodies, small boats, aircraft components, crash helmets, etc., are now being produced using polyester and silicone resins reinforced with fibrous glass, various types of fabrics, and asbestos felt.

Sheet and foamed plastics

Styrene sheet is manufactured to date by Walter Barr Pty. Ltd. and Emco Pty, Ltd., both of Sydney. The sheet, subsequently vacuum formed, is used especially for refrigerator liners and accessories. Two more firms will commence manufacture of styrene sheet in the very near future.

Foamed polystyene for insulating applications is produced by Hardie Rubber Co. Ltd. and H. F. Coates & Company Pty. Ltd., both of Sydney.

Foamed polyurethane is produced in Australia under license to Bayer of Germany by Cable Makers Australia Pty. Ltd., of Sydney, N.S.W. and S.A. Rubber Mills Ltd. of Victoria.

Plastics Institute of Australia

The Institute has played a major role in the development of this young industry, in Ausralia. Founded after World War II, it has since succeeded in binding the industry into a united body. Federal President is E. K. Stewart, M.A. with headquarters in Sydney. Recently, permanent secretaries were appointed for New South Wales and Victoria.

Conclusion

The plastics industry in Australia is growing rapidly. Not only is the molding and fabricating side expanding, but the introduction of new raw materials, and above all, public acceptance of and confidence in Australian produced plastics, promises a bright future for this industry.

Foam in a hi-fi speaker

Expanded polystyrene found to be ideal material for producing an acoustically efficient sound chamber at low cost

First stage in production of Sonosphere consists of pouring pre-expanded polystyrene beads into molds through a measuring-type hopper. Complete mold loading is insured by using blast of compressed air

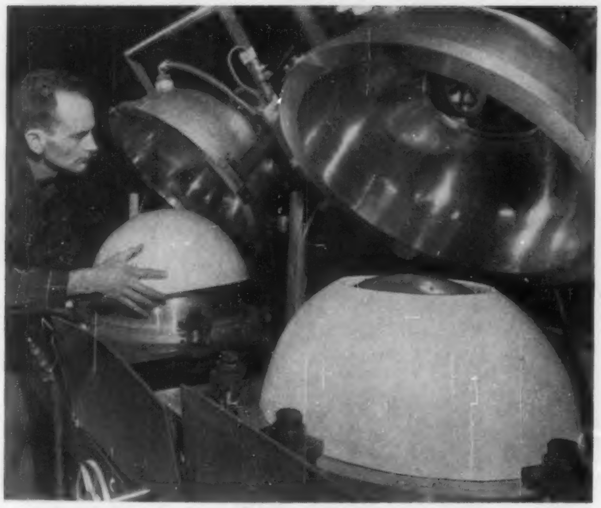
Spherically-shaped high-fidelity speaker enclosure molded of acoustically absorptive expandable styrene eliminates problems of cabinet resonance and sound distortion. (All photos, Koppers Co., Inc.)

The use of expandable styrene for molding a spherically shaped high-fidelity speaker enclosure has resulted in a revolutionary new type of speaker system that offers optimum performance characteristics and, at the same time, sells at a reasonable price.

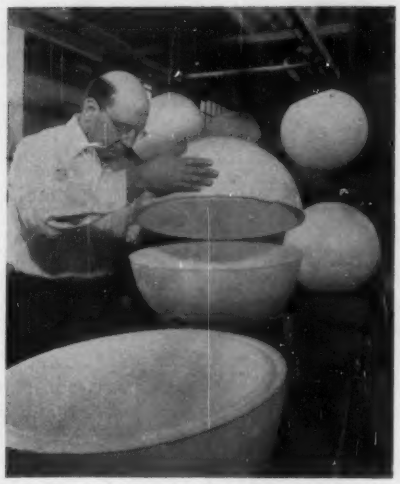
The design of the 18-in. diameter enclosure, which is being marketed under the tradename, "Sonosphere," by Plastilex Products, Inc., Philadelphia, Pa., is based on the theory that a sphere makes the ideal sound baffle, since it eliminates the possibility of the rear sound waves bouncing back and hitting the speaker cone—a major cause of distortion. From the acoustical standpoint, added efficiency is provided by the fact that the expandable styrene used to mold the enclosure is a unicellular material made up of millions of acoustically absorptive small air pockets.

Moreover, special techniques used during the molding of the enclosure provide dense, stiff inner and outer "skins" for the expanded wall section. These outside surfaces are acoustically reflective, acting as a vibrating extension of the loudspeaker cone and improve the low-frequency response of the speaker system. This gives the entire system the low-frequency response of a 15- to 18-in. loudspeaker, while maintaining the middle- and high-frequency response of the 8-in. cone and its coaxial tweeter.

From the standpoint of production economies, the ease with which the enclosure can be



After loading, the molds are locked, steam pressure is applied for a predetermined cycle, and cooling water is introduced into the mold. When the water has been drained, the molds are opened and the two halves of the speaker enclosure are removed



After molding, the two hemispheres are cemented together. One of the two halves is provided with an opening at the top to permit speaker installation. After cement sets, flash is removed

molded and assembled has made it possible for the entire unit, including speaker and baffle, to be placed on the market for less than $70.

Production techniques

The simplified design made possible by the use of expandable styrene calls for only two molded hemispheres to be cemented together. In contrast, wooden enclosures which do not cancel, or absorb, sound waves efficiently necessitate the use—at considerable expense—of skilled woodworkers to build special curved surfaces into the sound chambers.

To produce the Sonosphere, the pre-expanded Dylite styrene beads are loaded into the molds through a measuring-type hopper. An air blast is used to insure complete mold loading. To reduce equipment costs, molding of the large hemispheres is done on a specially developed "cycle control" molding unit, which incorporates a positive clamping device, instead of on a standard compression press.

After loading, the molds are locked, steam pressure is applied for a predetermined cycle, and cool water is introduced into the mold. The water is then drained off, the molds are opened, and the finished product removed.

Assembly consists simply of cementing the two hemispheres together to form the complete sphere. The small amount of flash that remains at the sphere's equator is removed after the glue has set. When each sphere has been provided with a suitable hole for the loudspeaker, it is painted. For added decorative effect, the spheres are being produced in four different surface textures.

Last step in the production of the Sonosphere is installation of the speaker; it is inserted into the molded-in hole and fastened by means of a self-tapping machine screw at each corner

Finally, the loudspeaker is inserted into the hole and fastened into place by means of a self-tapping machine screw at each corner.

In addition to its many acoustical advantages and low cost, the expandable styrene enclosure is structurally strong and will even bounce without damage if accidentally dropped. With speaker mounted, the entire unit weighs only 6 lb.—light enough to be easily moved around to suit particular acoustical requirements.

Credits: Dylite expandable styrene supplied to Plastilex Products by Koppers Co., Inc.

Flexible mop handle

Latest boon to the busy housewife is a dust mop with a flexible handle extruded of vinyl. Called the "Handiflex Mop," this work-saver eliminates any need for bending or stooping on the part of the housewife when cleaning hard-to-reach places under radiators, beds, chairs, and other furniture. The flexible handle now does all the bending while the user stands comfortably erect and expends a minimum of effort.

In addition to flexibility, the extruded vinyl handles offer other advantages: integral coloring eliminates the problems of chipping and peeling of paint associated with conventional wooden and metal handles; scratching and marring of furniture by the handle is minimized; and it can be easily cleaned by wiping with a damp cloth.

Credits: Handiflex Mop marketed by
Virginia Plastics and Chemical Co., Inc.,
Roanoke, Va.;
Geon vinyl supplied by
B. F. Goodrich Chemical Co., Cleveland, Ohio.

PLASTICS

Molded polyethylene sandals

Molded polyethylene sandals that flex with the movement of the foot have now been made available for beach, garden, and sports wear. The foot slips snugly under a flexible strap that hugs the arch and keeps the feather-light sandals from falling off.

Ribs molded into the bottom of the sole keep the sandals cool and enable the wearer to get a better grip when walking in sand. The sole will not chip or splinter, is strong enough so that it can be bent double without cracking or breaking, and has long service life despite daily contact with gritty sand and stony paths. The sandals can be washed clean of dirt or sand by simply rinsing in water. They are available in six sizes for men, women, and children.

Credits: Clog-hopper beach and shower sandals
are produced by Nu-Dell Plastics Corp.,
Chicago, Ill.; Bakelite polyethylene supplied by
Bakelite Co., a Div. of Union Carbide and
Carbon Corp., New York, N.Y.

Polyester-glass boat

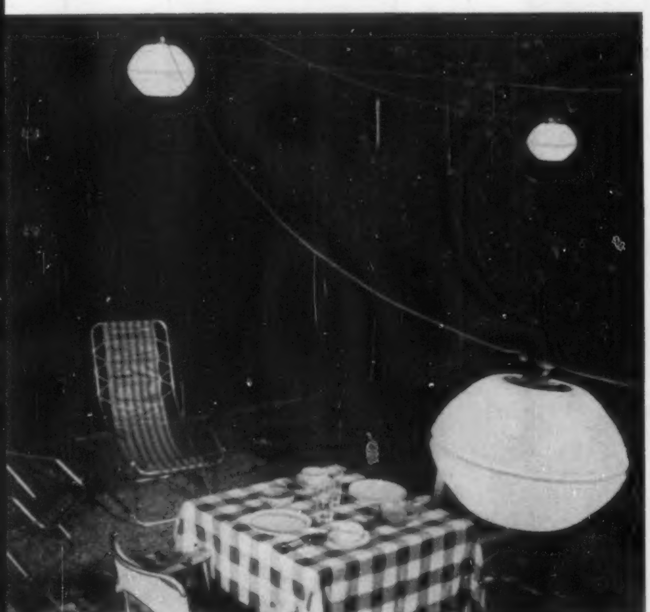
Maximum strength, stability, and durability consistent with an over-all weight of only 35 lb. is achieved in the design of a new canoe-type pleasure boat by molding the hull of the boat in one piece of reinforced plastics.

Using a hand lay-up technique, the hull (complete with keel and bilge keels) is turned out at low cost. Unlike wooden canoes, there are no rivets in the plastic hull, no seams to leak, and painting is unnecessary (white pigment is incorporated in the polyester resin formulation).

Dimensions of the boat are: 12 ft. 8 in. long, 33 in. wide, and 12 in. deep. For added flotation, styrene foam is bonded to the underside of the decks.

Credits: Minnow boat manufactured by E. Gitt, Springfield, Pa.; fibrous glass supplied by Owens-Corning Fiberglas Corp., New York, N.Y.; Paraplex P-43 polyester resin supplied by Rohm & Haas Co., Philadelphia, Pa.; Styrofoam supplied by The Dow Chemical Co., Midland, Mich.

PRODUCTS



Butyrate lanterns

Vacuum formed cellulose acetate butyrate "chinese" lantern shades, 11 in. in diameter, are the nucleus of an all-weather lighting system intended for backyard dining or outdoor living.

The system is made up of three of the shades spaced out evenly on 30 ft. of the neoprene-covered electrical cord to which they are attached. Metal hangers built into light sockets make it possible to hang the units from trees, roofs, or wires.

The lanterns are formed in two halves from 30-gage butyrate sheet. The two halves are snapped together with two interlocking undercuts formed around the periphery of each half. Holes in the top of the shade to accommodate the lamp and socket are die cut out of the formed sheet and aluminum fittings are riveted to each side of the hole to provide additional support.

Credits: Lam Lantern String manufactured by Lam Workshop, Inc., Wakefield, Mass.; butyrate sheet supplied by Southern Plastics Co., Columbia, S.C.

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Model	Maximum Molding Area	Maximum Depth of Draw	Maximum Depth of Drape
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Plastics Engineering*

Dr. James F. Carley, Engineering Editor

How to apply and sinter

Fluorocarbon coatings

By Gene Bartczak†

The properties and uses of fluorocarbon coatings are briefly reviewed. The application, drying, and sintering of these materials are discussed in detail, with particular attention to the most-used spraying techniques. The economics of the different coating techniques are compared and quality control methods are given.

The fluorocarbon resins, with their unusual chemical, mechanical, thermal, and electrical properties, are not newcomers to the industrial field. The basic resins, polytetrafluoroethylene (TFE) and polytrifluorochloroethylene (TFCE), are polymers containing no hydrogen. Somewhat idealized, their structures are as follows:

polytetrafluoroethylene (TFE):

$$\left[\begin{array}{c} \mathrm{F}\quad\mathrm{F} \\ |\quad\;| \\ -\mathrm{C}-\mathrm{C}- \\ |\quad\;| \\ \mathrm{F}\quad\mathrm{F} \end{array}\right]_n$$

polytrifluorochloroethylene (TFCE):

$$\left[\begin{array}{c} \mathrm{F}\quad\mathrm{F} \\ |\quad\;| \\ -\mathrm{C}-\mathrm{C}- \\ |\quad\;| \\ \mathrm{Cl}\quad\mathrm{F} \end{array}\right]_n$$

First use of fluorocarbons was in the form of molded gaskets, diaphragms, etc., in equipment handling extremely corrosive hydrogen fluoride, uranium hexafluoride, and others. No other existing materials could stand up in such service.

With the expanding use of molded plastics in the late 1940's, a demand arose for fluorocarbons in applications where, because of part size or complexity, use of molded materials was impractical or uneconomical. Coating materials were needed to fill such demands. Since the fluorocarbons have no known "room temperature" solvents, this need was met by preparing the resins in suspension form.[1] Such suspensions can be applied to large or small surface areas and fused into a continuous film (Fig. 1).

The baked-on fluorocarbon coatings are now found on brain-surgery instruments, bakery cookie rolls, magnet wire, and of course, chemical equipment. They have made possible entirely new

Fig. 1: Tank trailer, coated internally with 10 mils of Kel-F, is charged with sulfonic acid. Shorter-lived stainless steel caused metal-ion contamination of cargo. (Photo, The M. W. Kellogg Co.)

[1] These coating materials are available under six trade names: Bakelite fluorothene, Bakelite Co. (TFCE resin only); Corrocote, Chemical Coatings and Eng. Co.; Fluron, U. S. Stoneware Co.; Kel-F, M. W. Kellogg Co.; Pee Vee Seal, Atlas Mineral Products Co.; Polyfluoron, Acme Resin Corp.; Teflon, E. I. du Pont de Nemours & Co.

*Reg. U.S. Pat. Off.
†Gene Bartczak Associates, North Bellmore, N. Y.

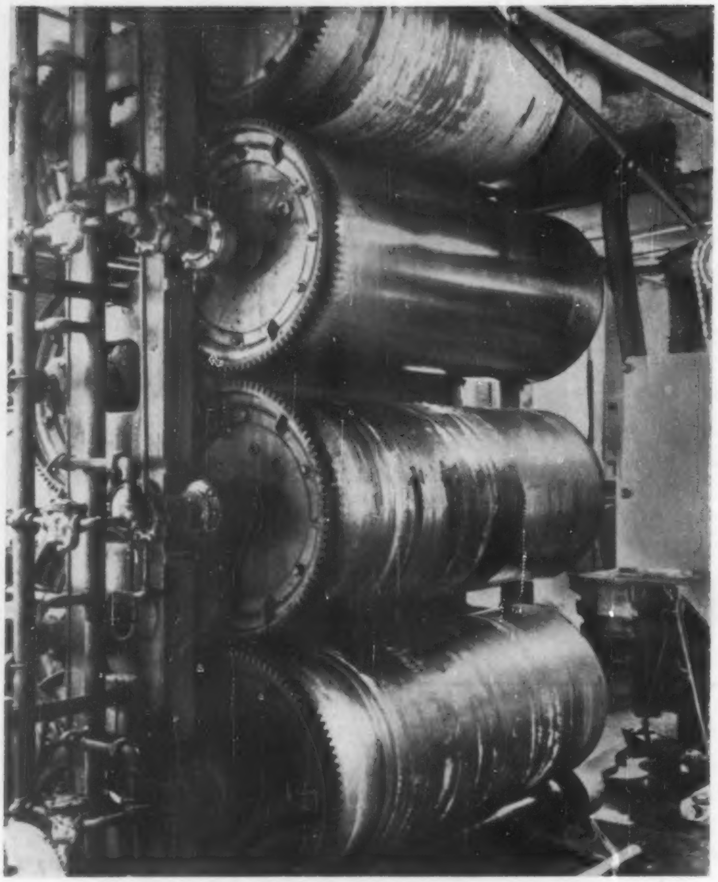


Fig. 2: Bank of steam-heated "cans" for drying textile fibers. Teflon-coated second can from top has needed only occasional wiping in five years to keep clean. (Photo, General Plastics Corp.)

high-temperature coated fabrics, wispy films used in sensitive controls, and "sprayed-in-place" dielectrics. They make excellent corrosion barriers, electric insulators, and release coatings on metallic and non-metallic surfaces.

Baked-on fluorocarbon coatings have essentially the same physical, chemical, and electrical properties as those of molded fluorocarbon components (1,2,3).[2] Their most striking characteristic, particularly of TFE, is practically complete inertness to attack by strong acids, bases, salt solutions, and solvents, even at high temperatures.

TFE films have fair resistance to impact and abrasion and good elongation, but they creep under load. The waxy, self-lubricating surface is excellent in antifriction applications where loads are not too high (4). The trifluorochloro polymer, TFCE, is characterized by higher tensile and compressive strengths, lower elongation, and excellent wear and abrasion resistance.

[2]Numbers in parentheses link to references listed on p. 243. Copies of Ref. 3 can be obtained from the author.

Non-stick properties

TFE has the best anti-hesive or "non-stick" properties of all fluorocarbon materials; in this property it is superior to any other durable material. Dyes, glues, latex, doughs, paints, adhesives, candies, and casting resins are examples of materials that do not adhere to TFE. The steam-heated textile drying cans shown in Fig. 2, above, handle dyed and sized fibers that are extremely adhesive. The clean can is Teflon coated, and, unlike its companions, need merely be wiped clean instead of being dismantled, scraped, and burned free of adhering material. Another example of TFE anti-hesion character is the dye pan, Fig. 3, p. 129.

Other equally impressive results are a matter of record in latex equipment, package forming, and sealing machines. Although anti-hesive properties of TFCE are not quite equal to those of TFE, the wing-whip beater-blender (Fig. 4), has a 10-mil coating which performs a triple function: it provides ready release of mixtures, both dry and wet, and it resists the effects of plasticizers and the eroding action of abrasive particles.

Another example of this triple function is in the lead stationary roll of a paper mill. Over 22,000 miles of paper have passed over it, without grooving the roller. According to the users, "the longer it is in use, the more slippery it gets!" Similar results are reported in lithographic plates where impermeability is also important.

Thermal stability

TFE coatings will give good continuous service at 480 to 550° F., and for short periods can withstand temperatures up to 575° F. The corresponding limits for TFCE are 390° F. and 420° F. Because of their superior thermal stability TFE coatings have been used for magnet wire operating at high temperatures and even for making a self-cleaning lining for pans used to cook souffles! However, traces of toxic decomposition products are evolved at about 450° F. from TFE, as compared with approximately 570° F. for TFCE.

Both are non-flammable, will not support combustion, and are unaffected by open flames unless the above temperatures are exceeded.

At the other end of the temperature scale, all these materials have good properties to −150° F. or lower.

Materials available

The most durable and protective fluorocarbon coatings are made from fluid suspensions of finely-divided resin particles which are applied and dried, then

fused into a continuous film or envelope at temperatures as high as 750° F. TFE is available in aqueous suspension, while TFCE suspensions are based on hydrocarbons or mixtures of hydrocarbons and plasticizers. These suspensions also contain wetting agents. All solids except the fluorocarbon resins are volatilized during fusion.

Dispersion formulations available cover the entire range of application possibilties, providing resin contents varying from 25 to 60% by weight. See Table I, p. 131. To facilitate both application (coverage) and fusion of resultant films, resin particles in suspension have an average "size" of 0.5 micron for TFE dispersions, while those of TFCE average approximately 3 microns in diameter. Small particles are required since the fluorocarbons have an extremely low thermal conductivity and increased surface area facilitates rapid fusion, flow-out, and coalescence into a continuous film with minimum thermal degradation. High solids content and low viscosity are added benefits from small particle size.

The TFE systems currently consist of three primers, eight top coats (including pigmented enamels), and a special "one-coat" enamel which requires no primer undercoat. Table II, p. 140, indicates recommended individual coat thicknesses and other data. In general, primers are applied up to 0.6 mil thick, clear and pigmented top coats up to 1 mil, and only black enamel up to 2 mils. "Clear" Teflon offers the maximum in desirable properties.

Of the TFCE coatings, Kel-F NW-25TR is supplied for general spray application, "N-2" for general dip, doctor, and brush application, "N-1" to use as a "resin bank" with which to increase viscosity of other preparations, and a high-temperature primer, PN-25, used as an undercoat to provide maximum bonding to substrates. From primer to top coat, the indicated laydown with these materials is between 2 and 2.5 mils (fused basis) although as much as 6 mils can be applied before fusion without danger of "mud-cracking (3)."

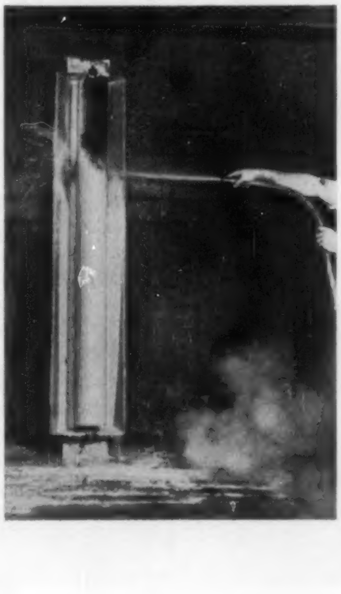
There are two primers and five resin formulations based on Polyfluoron: "Primer 140" and "Primer 150" for use as undercoats in much the same manner as the Kel-F primer; four topcoat formulations in solids-content ratings to satisfy requirements of spray and dip viscosities; and a concentrated resin-vehicle paste from which new formulations may be compounded as required. All are supplied in "low," "medium," and "high" NST values (NST value is a measure of molecular weight).

Storage characteristics

TFE dispersions have shelf lives ranging from one month to one year, if they are kept above freezing (32° F.) and not stirred too vigorously. Violent stirring and temperatures outside this range are conducive to irreversible coagulation of work-sensitive resin particles.

Clear TFE finishes and colored enamels are stable for one year at room temperature. Primers and "one-coat" enamel are stable for one month at 70 to 80° F., but will last up to ten months at 40° F., and are therefore usually refrigerated. Acid in these formulations slowly generates gas that must be vented at intervals.

Fig. 3: Teflon-coated dye pan and roller used in coloring textiles is easily cleaned with warm water. (Photo, General Plastics)



In TFE spray equipment acid-resistant hose, such as Saran, is usually substituted for the conventional rubber hose to minimize contamination. Left-over dispersion is stored in polyethylene, stainless steel, or TFE-coated containers; it is never returned to original containers for reasons of contamination.

Of the TFCE coating materials, Polyfluoron has an established shelf life of three years at room temperature and can be stored within the range of −4° F. to 266° F. Kel-F formulations have indefinite shelf lives. But both Polyfluoron and Kel-F preparations must be protected against loss of their volatile vehicles.

All three classes of fluorocarbon dispersions contain either potentially toxic or irritating components. Some are inflammable. Therefore, respiratory masks and good ventilation are essential in working with these materials.

Materials that can be coated

Materials to be coated with fluorocarbons must not soften or corrode at the relatively high temperatures needed to fuse the resins. TFCE is fused at 475 to 525° F., while Teflon is fused at 650 to 750° F.

Coatings can be applied to most ferrous and nonferrous alloys, iron, steel, glass, glass cloth, asbestos, smooth and porous ceramics, as well as plated metals. TFCE, because of its lower fusion temperature, can also be coated on magnesium and lower melting metals. Copper-base alloys and some others form oxides at fusion temperatures that can cause subsequent peeling of coatings due to low adhesion. Copper is particularly difficult since it catalyzes TFCE degradation. Plating of such active surfaces with tin, nickel, silver, and cadmium makes them coatable.

Lower fusion temperatures have been tried in an attempt to widen application range. Some TFE coatings for high-humidity service have been "cured" at temperatures as low as 350° F., 400° below recommended fusion temperatures. For this same service, TFCE has been applied as low as 420° F., approximately 80°

Fig. 4: Sigma blender rotor, coated with Kel-F resin, is unaffected by abrasive plastics particles which erode polished alloy-plated steel blades. (Photo, A. Gusmer, Inc.)

below fusion temperatures. Such coatings are highly porous. The ultimate chemical, electrical, and mechanical properties of both types of coatings, which depend on fusing to continuous films, can, however, be obtained only through fusion at recommended temperatures.

Size limitations

There is no minimum size of objects to be coated. Even fine-caliber medical hypodermic needles are internally coated to reduce contamination. The maximum is limited only by the capacity of available baking or fusion ovens. The art has progressed so that entire tank cars have been coated and fused in newer facilities that allow application and fusion by a continuous technique instead of in stages.

Design of parts to be coated

Adhesion of fluorocarbon coatings to substrates is essentially mechanical. In "covering" coatings, the materials form a gripping envelope around the substrate. Because of this dynamic enveloping, which is due to shrinkage, sharp knife-life edges or projections should be rounded before coating is attempted. Cracks, hairline crevices, and pores should be sealed with weld metal and flush-ground. Welds should be continuous, non-porous, and ground smooth. Weld quality is important since porosity and weld spatter provide foci for subsequent coating tension and possible puncture. Iron castings are sometimes difficult to coat with continuous films: TFE resin "sucks" into recesses, will not fuse completely due to its "critical-thickness" factor; TFCE, on the other hand, will bridge the very small capillary pores found in low-grade castings. This results in blistering and in pin-holes during baking of a multiple-coat film. Dense castings, however, have been successfully coated with both resins.

Preparation for coating

The usual preparatory practices for applying other organic and inorganic coatings should be followed. In addition, the working area must be free of contamination by dusts or by vapors from any other coating materials in use or previously used. Even minute traces of less stable materials in a fluorocarbon film would significantly downgrade its protective properties, especially in highly corrosive service, where inclusions, essentially, are pinholes. The entire coating can be undermined.

Oil, grease, dirt, rust, or mill scale are removed by the usual chemical and mechanical methods. After being cleaned, the substrate must be roughened to hold the fluorocarbon film. Smooth surfaces such as plated metals, glass, and fired ceramics are roughened with a light-to-moderate sand blasting to provide a good "tooth." With TFE an important variation is necessary because of the resin's high fusion temperatures: prior to sanding or sand blasting, surfaces are preheated to above 750° F. to drive off any organics embedded in metal pores or in the seams of fabricated items. This eliminates "out-gassing" after the primer or first coats are applied and prevents blow-outs of the film during fusion.

Only a very light sanding or low-pressure sand blasting with extra-fine grit is employed in preparation for Teflon coating. Excessive pitting is avoided to prevent bridging and incomplete fusion of resin. Rust spots are removed by "dry" methods using steel wool or #400 emery cloth, rather than "wet" methods depending on acids which may cause oxidation. After "out-gassing" and roughening, the surface is cleaned with a hydrocarbon solvent to remove any dust or oils which may have been deposited during handling. To protect surfaces which corrode rapidly, kerosene or other high-boiling solvent is added to the volatile solvent wash to leave a residual protective film. This residual film is readily and completely driven off during the initial phases of fusion of Teflon primers or finish coats.

With TFCE coatings, a similar surface-preparation procedure is followed, with the exception of the roughening of the surface. Sand-blasting is done with #25 coarse abrasive grit and moder-

Table I: Dispersion specifications

Coating material	Resin content	Vehicle	Viscosity	Coverage (1 mil thick)	Weight	Shelf life	Remarks
	%/wt.			sq. ft./gal.	lb./gal.		
TEFLON							
Steel primer	46			475	11.5	10 mo. at 40° F. or 1 mo. at 70-80° F.	Resin particle size: 0.5 micron. Reduce with distilled water or acetone for corrosion-resistant coatings.
Aluminum primer	48			496	11.5		
Primer green				500	11.8		
One-coat enamel	48			505	11.8	1 yr. at 70-80° F. Store opened portions in acid-resistant containers.	
Clear finish	48	Aqueous	Spray and dip	473	11.0		
Blue				475	11.0		
Yellow				475	11.0		
Green				475	11.0		
White enamel	45			440	11.0		
Gray enamel	45			440	11.0		
Red enamel	42			400	10.6		
Black enamel	41			385	10.4		
KEL-F							
N-1	35	Xylene type	32-34 sec. (Zahn)	—	—	3 yr.	Resin particle size: 1-20 microns (avg.: 3 microns); Reduce dispersion with acetone, amyl acetate, or xylene; Primer with MEK. NW-25-TR has lower coverage due to wax content.
N-2 (dip)	40	Amyl acetate type	9-10,000 c.p.s.	330	11.5-12.2		
NW-25-TR (spray)	38	Xylene type	35-39 sec. (Zahn)	265	11.5-12.2	Probably indefinite. Guard against vehicle loss.	
Primer PN-25	40	Xylene	30-36 (Zahn)	300	11.5-12.2		
POLYFLUORON							
Paste 40			1800-1980 c.p.s.	—	12.0	Indefinite. Guard against vehicle loss.	Reduce Primer 150 with water, 140 with toluol. Reduce Polyfluoron dispersant with methyl isobutyl ketone, acetone, or toluene. Resin particle size: approx. 3 microns. Low, medium, and high NST.
Primer #150	—	Proprietary chlorinated hydrocarbon	84-88 c.p.s.	—	7.8		
Primer #140	—	Aqueous					
Dip	35		1050-1100 c.p.s.	340	10.5		
Spray	30		290-315 c.p.s.	225	9.3		
Dip	25		60-80 c.p.s.	—	8.8		
Spray	22		—	—	Aerosol can		

ately high-velocity air streams. This is a much coarser grit than is used for TFE substrates.

Generally, all traces of foreign material must be removed before application of the dispersion is attempted. "Second hand" grit that has been used to remove other types of coatings and linings, especially the organics (neoprene, phenolics, vinyls) and corrosion products such as chloride and fluoride salts, should not be used to grit-blast surfaces preparatory to fluorocarbon coatings (5). Such contaminants imbed in substrates and usually cannot be removed even by hot degreasing vapors and liquids. Organic contaminants decomposing at high temperatures can cause blistering of the fused fluorocarbon film. Wash materials used for other coatings, such as phosphates and chromic acid solutions, are not used for the fluorocarbons because of the difficulty of complete removal. However, in cases of non-volatile alkali permeation of substrate, neutralization by dilute phosphoric or chromic acid after roughening and before applying TFE primers is practiced. Any surface impurities in metals do not normally affect adhesion or performance but may cause undesirable stains or splotches.

Adhesion of TFCE to glass and porcelain is generally poor even after grit blasting because of the resin's resistance to capillary flow. However, constriction of the coatings pulls them tight around the coated object after fusion. Glass cloth should be heat-cleaned prior to coating to remove any organic sizing agents. Then it should be pretreated with a chrome complex or a vinyl silane (finish 114, 136, Volan or Garan) to restore high tensile strength and to provide improved wetting and penetration by the Kel-F dispersion.

Once substrates are prepared for coating, they should not be handled except with lintless gloves or clean equipment; they should not be allowed to accumu-

(To page 134)

STOKES *news and views*

Model 741 Press Features Set New Performance Records

Weston Electrical Instrument Corporation, a subsidiary of Daystrom, Inc., gets real savings . . . improves quality

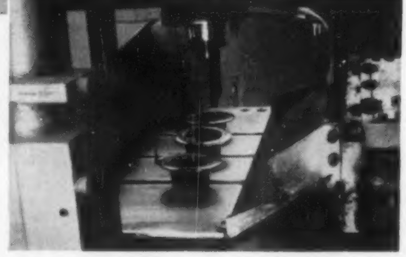
Phenolic flush cases for famous Weston meters are now being produced to new standards of economy, quality and uniformity. Since a Stokes Model 741 50-ton fully automatic compression molding press has been on the job, labor costs per piece have been substantially reduced. Overall production costs are now 20% lower . . . output per shift per operator has jumped 140%.

The 3½-inch-diameter meter cases are molded three at a time. A single press operates at a rate of 20 complete molding cycles every hour, 24 hours a day . . . a total production of more than 1400 meter cases daily. The design and construction of each Model 741 feeder exactly matches the requirements of the die with which it is used . . . affording minimum material usage and maximum production of quality parts.

This high production requires only a fraction of an operator's time. All the operator needs to do is load molding powder into the hopper, remove barrels of finished parts, and occasionally check on the functioning of the press. Simultaneous, cushioned action of feed and comb permits ejection of parts while new charge is being fed . . . maximum percentage of total press cycle is devoted to curing.

Write to Stokes today for Bulletin No. 506, "Stokes No. 741 Completely Automatic Plastics Molding Press", for full data on this complete molding plant . . . and for a consultation on how it can be profitably applied to your specific molding work.

Typical Weston meters: cases are molded at the rate of 1400 per day on a single Stokes Model 741 press.



Close-up of parts leaving mold. Positive seal between feed and comb prevents parts from falling back into die . . . a Stokes exclusive feature.

Model 741 press at Weston Electrical Instrument Corporation molds cases for 3½" meters completely automatically. Finished cases are sliding from chute into tote barrel. Operator can make all necessary machine adjustments from a single control panel.

all necessary machine adjustments from a single control panel.

late dust. White protective clothing for workers is recommended as an aid to maintenance of clean conditions. In practice, substrate preparation and application of the first coat of dispersion are scheduled for one working day to minimize delay between the two stages. Subsequent coats will require only dusting with a lintless cloth, wet with a volatile solvent, then drying and application of the second and succeeding coats.

Coatings may be pressure-sprayed, dipped, cast, doctored, or brushed onto properly prepared surfaces. The spray technique, utilizing standard pressure spray equipment, compensated to handle the various formulations, is discussed here. With but few changes, the various other application methods utilize principles comparable to that used for spray coating.

Spraying equipment

Although equivalent equipment of other manufacture is equally suitable for spraying TFCE coatings, M. W. Kellogg's Applications Laboratory found these sprayers to provide satisfactory results: For general use, with a syphon cup: A) Spraco Model 14C with air nozzle N and N 4AN and with a size N needle; B) Bink's Model 19 gun with material nozzle size 66, air nozzle #66S, and needle valve #15.

For small parts or where intricate surfaces are encountered, such as recesses in plug and diaphragm valves, the Paasche air brush, with a type H nozzle and set-ups #3 and 5, affords proper control of spray pattern and deposition (Fig. 5). For deep recesses in a cylindrical or tubular drawn cross-section, the Paasche AURF 3 multiple-head airbrush with a 6-in. extension (45° elbow) and the Paasche CUF airbrush with a 36-in., 45° elbow "BU" extension provides required control of a 360° spray pattern to eliminate undesirable overlap and over-spray.

For general use with pressure cup or tank: Bink's Model 19 with a #63 material nozzle, a #63P air nozzle, and a #5A needle valve.

The balance of the equipment is comparable to that used for other coating materials, the materials tank being equipped with an air-driven agitator (fed from a separate air line) to keep resin particles from settling during the spraying period. Two separately regulated air lines supply 20 to 30 p.s.i. to the gun and 3 to 4 p.s.i. for material flow. Standard gun and tank equipment is used for special-purpose spraying of pipe and closed tank interiors where a 360° spray pattern must be maintained (Fig. 6). Equivalent equipment is equally effective if air and material nozzles are carefully selected for proper atomization and air pressures are controlled accurately.

In syphon guns, spray pressures are kept only as high as necessary to aspirate material from the cup, usually about 15 to 20 p.s.i. With pressure guns, 3 to 4 p.s.i. is usually sufficient to force material out of the gun, with a suitable pattern obtained with 20 to 30 p.s.i. atomizing air pressure.

Acme Resin has found that the De Vilbiss MBC gun with a P-KN-519 pressure can is excellent for spraying large objects with Polyfluoron (TFCE), since various nozzle lengths can be attached. When spraying with a 20 to 30% solids-content dispersion, 15 to 20 p.s.i. are used on the atomizing line and 10 p.s.i. on the material feed. For small objects, the De Vilbiss REGA-502 touch-up gun is preferred. In experimental or touch-up procedures, Acme's aerosol spray bombs can be used for both primer and finish coat application.

TFE primers and finish coats are applied either by suction or pressure spray. The De Vilbiss gun with an E tip and #30 cap can be used with 25 to 45 p.s.i. air pressure for suction spray. A #704 cap and FF tip can be used with the same gun equipment with a pressure pot. Satisfactory air pressures range from 3 p.s.i. on the fluid feed, to 30 to 45 p.s.i. on the air or atomizing feed (Bink's #18 gun, 66 X66 SD nozzle for suction spray, Bink's #18, 63 Bx 63PB nozzle for pressure spraying). Other equivalent spraying equipment is suitable. As with TFCE, small touch-up guns are recommended where practicable to reduce spray losses and over-spray. TFE also adapts itself to electrostatic spraying methods.

TFCE, during application, can be uniformly suspended by vigorous agitation in the spray container, but caution is needed with TFE due to its susceptibility to permanent coagulation if excessively worked. All dispersions must be kept clean and well dispersed during the application phase.

The chlorofluorocarbons are supplied for spray application in "ready-to-use" viscosities. Should it be necessary to lower the viscosity of Kel-F dispersion NW-25-TR, xylene is used; Polyfluoron is reduced with the special chlorinated hydrocarbon "Dispersant A" supplied, or with acetone. Teflon primers, enamels, and clear finish are also supplied

Fig. 5: Touch-up gun is used to coat complex and small object with Kel-F to assure complete coverage and reduce spray losses. (Photo, M. W. Kellogg)

at spray viscosities but can be reduced with up to 20% by weight of distilled water, or up to 7% with acetone to improve fused film impermeability and corrosion service. To keep any coagulated Teflon particles from clogging gun orifices, dispersion is transferred to the spray container through muslin to strain out particles larger than 0.5 micron.

Spray techniques

In establishing a satisfactory lay-down, a distance of 3 to 4 in. is maintained between gun and work (depending on its shape) at atomizing pressures of 25 to 30 p.s.i. If this distance causes rippling in the wet film, distance is increased to 6 to 8 in. with pressures increased to 45 p.s.i. with a vacuum-type gun (see Fig. 7).

A typical procedure for coating a flat surface with Kel-F provides for a syphon gun at 15 to 20 p.s.i. working at a distance of 6 inches. An experienced operator can cover 500 sq. ft. in three hours using a four-pass pattern for uniformity. A 45° spray-fan pattern is established and moved at a rate so that six passes (alternate vertical and horizontal) deposit a smooth, slightly "orange peel" coating of about 10 mils (2.5 mils after fusing). After baking, the procedure is repeated to achieve the desired total film thickness. The same procedure applies to primers except that after fusion of the first coat of primer, the second coat is a mixed primer/virgin TFCE deposition. During coating of large vessel interiors, the air exhaust is away from the newly sprayed surfaces so that suspended spray falls on as-yet-unsprayed surfaces.

TFE enamels are applied with little or no "orange peel," which would lead to dry and spongy coatings. The clear finish can be sprayed dry enough to show spray wave or orange peel which will flow out somewhat in the air-drying period and still more on fusion. A little orange peel gives thicker films without mud-cracking, but too much subdues the characteristic gloss of the air-dried film, resulting in a discontinuous fused film. Ideally, primers are applied in 0.2- to 0.4-mil thickness (dry-film basis). Enamels and clear finishes are limited to 1 mil (dry film). Teflon "1-Coat" enamel is safely deposited in 0.7- to 1-mil dry-film thicknesses. Black enamels, containing flowing agents, are applied up to 2 mils per coat without danger of detrimental mud-cracking.

Fig. 6: Sliding extension gun on rotating jig provides uniform coverage, prevents sagging of dispersion in tubular object. (Photo, A. Gusmer, Inc.)

With the exception of the Teflon "1-Coat" enamel, all TFE finishes require a TFE primer for a satisfactory bond. A typical coating application on a prepared surface would be: 0.4 mil primer by spray, followed by air or oven drying, then baking or sintering at 750° F. Enamel or clear finish is then applied by spray up to 1 mil (up to 2 mils if "black enamel"), then flashed and fused. Two coats, one of primer and another of enamel or "clear," are always applied to metals that oxidize at fusing temperatures. Top coats for corrosive service are usually "clear" finish, since these are superior to enamels or pigmented finishes in impermeability. Top coats can be repeated one on top of the other with flashing and fusing in between to build up the required thicknesses. Primers and "1-coat" enamels cannot be applied on themselves.

TFCE dispersions can be applied directly to substrates with reasonably good adhesion. In highly corrosive or thermal applications, Kel-F and Polyfluoron use PN25 and #140 and #150 primers respectively, to obtain maximum adhesion. The lay-down procedures for both Kel-F and Polyfluoron primers are similar to those for the virgin resin except that primer coats are 2 instead of 4 mils thick. With Kel-F, the second or "mixed coat" is 1 mil primer plus 1 mil of Kel-F on the wet primer film.

Coatings as thick as 25 mils have been applied using Teflon; no coating thickness limit is set for Polyfluoron. Kel-F coatings have a practical limit of 25 to 30 mils and a theoretical upper limit of 60 mils (6). Total film thickness is governed by total baking time to which the first virgin coat has been exposed. Degradation of resin proceeds when it is maintained at temperatures above 412° F. See Table II for specifications.

In none of the coating systems can over-spray or "running" be tolerated. Blistered and cratered fused coatings result from too thick a film. In the event of faulty spray techniques, it is best to remove dried coatings by wiping with a clean, solvent-wet cloth. Localized over-spray can be corrected by scraping and repeating the spray process.

Flashing of applied films

After application of the individual wet films, prior to fusion, the fluorocarbon dispersion coats are dried or "flashed" at room or oven temperatures. This drives off volatiles which, if retained and released during fusion, result in voids in the finished fused film. TFE films are completely dried, but TFCE films are not: if they are, the result is a rough, powdery coating that does not consolidate into a continuous film on fusion.

Flashing time will vary with the material used, the design of the coated object, and atmospheric conditions. The completeness of drying can be determined visually. Teflon finishes can be air-dried for 5 to 10 min. or oven-

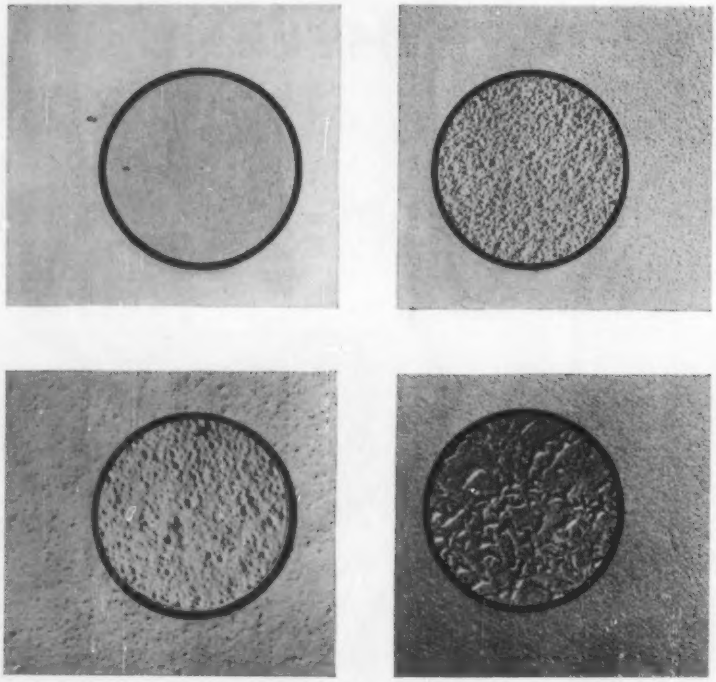


Fig. 7: Good and poor application techniques: upper left—*good;* smooth; applied at recommended air pressure; upper right—*poor;* rough; pressure too high; lower left—*poor;* multiple pass, applied when preceding pass still wet; lower right—*poor;* fused but mud-cracked; intermediate coats too thick. (Photos, M. W. Kellogg)

dried at 180 to 200° F. for 3 to 5 min. to complete dryness. Primers show a definite change from a light to a deep brown on drying. Clear finishes will change from a milky white to translucent film. In colored enamels, a general deepening of color takes place. Black enamel *must* be air-dried at room temperatures.

In applying unpigmented Kel-F dispersions, each pass is air-dried to a dull gray before succeeding passes are applied. The coating is never allowed to become bone-dry between passes, otherwise blistering will take place on fusion. After the final pass, it is allowed to dry to a white, opaque appearance. The same procedure is followed to the same visual check point when using Kel-F primers for corrosion work.

The Polyfluoron coating materials, similar to Kel-F, are dried in like manner. Polyfluoron primer 140 is applied in 0.5-mil thickness and fused immediately. Primer 150 is air-dried for 1 hr., or oven-dried at 475° F. for 20 sec., followed by application of Polyfluoron, which is then dried and fused. Primer is never allowed to "set" completely, otherwise top coats will not adhere.

Fusion of coatings

The final step in fluorocarbon coating is the fusion of individual "coats" into a continuous, dense, uniform film (see Fig. 8 for comparison of dried and fused surfaces). The "melting point" of TFE is 620° F., but for complete sintering oven temperatures must be maintained between 700 and 750° F. TFCE melts at 412° F. and fusion ovens are maintained at 480 to 520° F. Accurate control of fusion temperature is considered essential.

Ovens must be ventilated to remove water, the acidic components of TFE dispersions, volatile solvents, and TFCE plasticizers. With TFCE, gas analysis is recommended in large vessel interiors to be sure that explosive vapors are kept down to a safe 1%. Conversely, to reduce bubbling, Acme recommends that Polyfluoron coatings on objects of large mass be sintered in a vapor-loaded atmosphere, by using an oven of slightly greater volume than the coated object, or by decreasing rate of vapor removal.

Sintering of TFE on small or "spot-coated" objects can be done in gas-fired or electric ovens, or with infra-red or induction heaters. Teflon will not deteriorate on short-time contact, but can become brittle under long exposure.

TFCE does not enjoy this latitude. Open, concentrated sources of heat are not recommended. Ovens for fusion of Kel-F must maintain temperatures within 5° of the 520° F. indicated to prevent over-baking and coating deterioration. Exposing Kel-F coatings to excessive temperatures for undetermined periods degrades it to brittle, lower-molecular-weight materials. Care must also be taken to prevent under-baking, which can result in discontinuousness and permeability. Temperatures above the melting point (412° F.) are needed to "flow out" the discreet resin particles into a smooth, continuous film. Higher temperatures decrease melt viscosity and result in more rapid fusion, but increase the risk of degradation.

Sintering time varies among the several dispersions and according to shape and mass of substrates. Sintering times of TFE primers are not readily determined by visual methods and must be found by trial with the given situation. Small test panels coated with TFE clear finish are placed in positive contact with the primer-coated objects to be sintered. Sintering is considered complete when the "clear" panel finish changes from a milk-white (its air-dried appearance) to a clear, almost transparent film. Another control trick is to apply a drop or two of "clear" finish to an uncoated portion of the primer-treated surface to be heated. With other TFE finishes, sintering time varies from 4 min. for 1/16-in. substrates to 22 min. for 5/8-in. thicknesses; heavier substrates are timed by visual methods.

Teflon coatings on surface-active materials such as copper-base alloys are not usually fused at 750° F. but require control of temperatures to the lower range

of 680 to 700° to provide for slow but complete consolidation of films. At these lower temperatures the surface activity of such substrates is negligibly slow, and good adhesion is obtained.

In most cases, an object with a dried coating is placed directly into a preheated oven rather than into one at room temperature. But with extremely thin hollow sections, the oven may be brought up from room temperature to minimize structural distortion through thermal shock.

The lower limit for sintering TFE coatings is 680° F. Moderately good primer and "one-coat" enamel films can be produced at 350 to 450° F., but with much longer baking periods. Such temperatures are used, for example, to coat surfaces plated with low-melting metals or surfaces that oxidize rapidly at higher temperatures. At such low sintering temperatures consolidation is not complete; therefore, such films are inferior in all properties except water vapor transmission and anti-hesion.

The sintering time of Polyfluoron, also, depends on the mass of the coated object. Duration varies from 20 sec. for a coated #30 wire to 15 min. and more for ¼-in. bar stock and objects of greater size. A complete 4-coat, 20-mil film on 20-gage steel can be fused in 1 hour. Again, the completion of TFCE fusion can be determined visually; the coating changes from an opaque white to transparent for the resin alone, or to light-brown for primer and resin mixtures.

After fusion of the last Polyfluoron coat, the coated object is subjected to a "post-fusion" cure. Fused coatings are exposed to 475° F. oven temperatures for an additional 1 to 2 hr. to smooth out the film, close up pinholes, and impart a gloss to the surface (7).

Duration of fusion of Kel-F dispersions, without regard to the mass of the object being coated, is measured from the instant at which substrates reach preheated oven temperature. Coated objects are placed in a 380° F. oven, held until substrate temperatures reach this level, and then the oven temperature is increased gradually until the entire object reaches the sintering temperature. This procedure is slow but eliminates the uncertainties inherent in the faster sintering procedures used with TFE and Polyfluoron.

There is a choice of two fusion temperatures for Kel-F coatings: 480 or 520° F. At 480° F., each individual coat is sintered for 1 hr. after the substrate reaches this temperature. The final coat is fused for a time that is the difference between the total fusion time of intermediate coats and 16 hours. When operating at 520° F., each individual coat is fused for ½ hr. after the substrates have reached oven temperatures. Final coats are fused for a period equal to 9 hr. minus the total fusion time of intermediate coats.

Safety measures

Trace quantities of gaseous fluorine compounds evolve from TFE resin at temperatures above 400° F., and measurable quantities evolve at temperatures of 600° F. and above. At approximately 750° F., TFE begins to decompose slowly; at 950° F. it decomposes rapidly. The resin is completely inert at room temperature and has no effect when ingested. Breathing or contacting decomposition products, however, is hazardous. Coating and sintering areas must be well ventilated and personnel furnished with protective masks. Caution should be exercised in open-flame fusion of Teflon coatings, in grinding fused coatings, or in applying intense localized heat to coatings. Smoking should not be permitted.

TFCE gives off no measurable amounts of toxic fluorine or chlorine compounds until a temperature of 550° F. is reached; then only minute quantities of gaseous fluorine and hydrogen chloride may be evolved. Active decomposition by molecular scission takes place at temperatures above 700° F. yielding lower molecular-weight, gel-like products;

Table II: Coating recommendations

	Teflon	*Kel-F*	*Polyfluoron*
Deposition (mils per pass)	Primer: 0.4 Finish: 1:0 Black top-coat enamel: 2.0	2 to 6 Primer :2 1:1 mixed primer and dispersion :2	4 to 10
Total thickness, mils	20	20 (60 possible)	20
Fusion temperatures	680-750° F.	480-520° F.	475-525° F.
Fusion time, each pass	18-22 min. (heavy sections more)	½ - 1 hr.	4-20 min.
Final pass	same	16 hr. minus total "pass bakes at 480° F. or 9 hr. minus total "pass" bakes at 520° F.	2 hr.
Coating thickness, total in mils			
Anti-stick	0.7-2.3	4-6	3-4
Thermal	0.7-1.0	......	0.5-1.0
Corrosion (light)	6-8	10+	4 + primer coat
Corrosion (heavy)	8-20	15+	8
Elec. insulation	3-6	10	5-10
Water repellent	0.7-2	4-6	3-4

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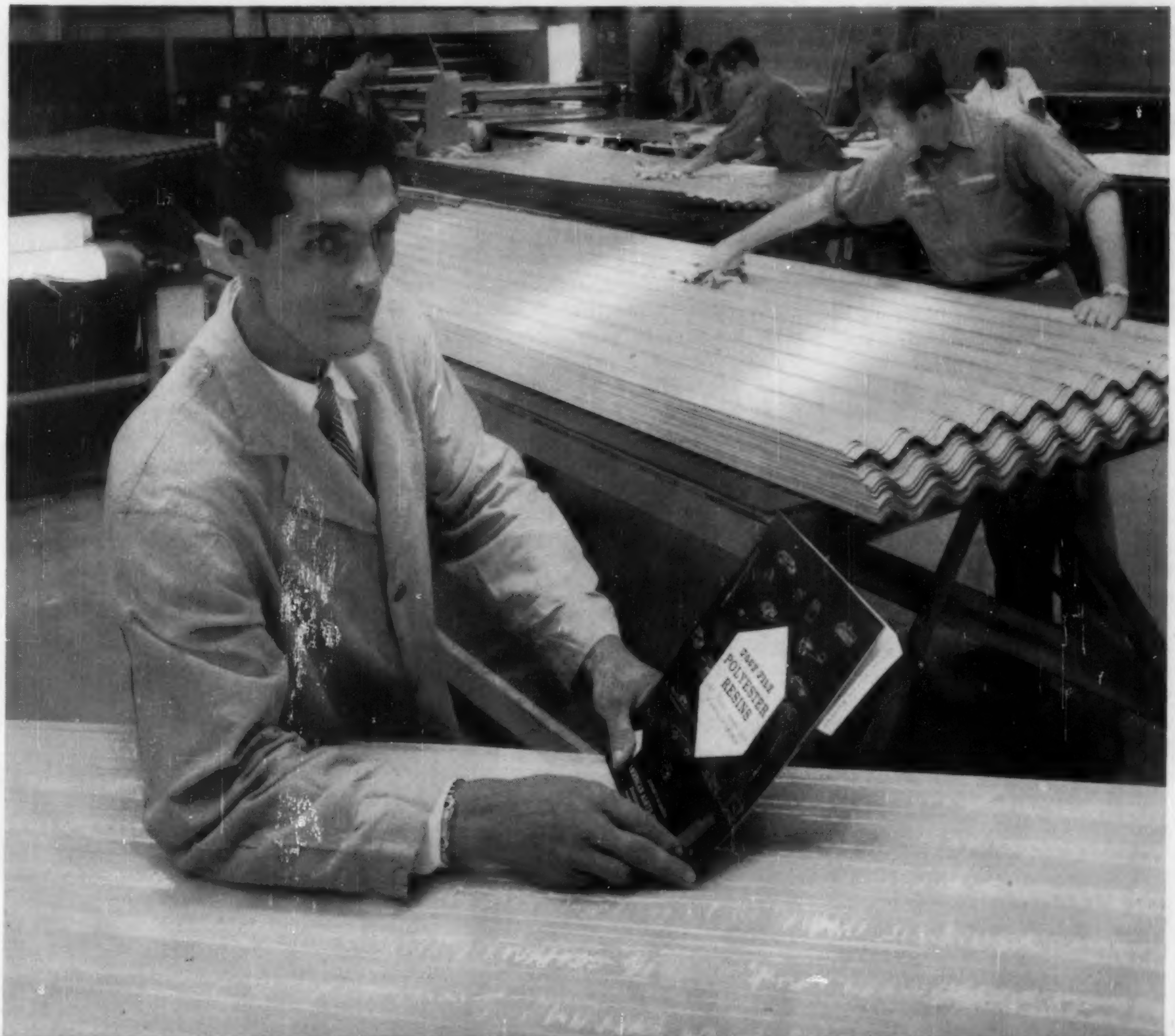

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AMESTER 722 L. S. (RIGID, LIGHT STABILIZED RESIN)

Typical Liquid Properties:

Solids	100% reactive
Monomer	Styrene
Viscosity (Gardner - Holdt)	T - U
Viscosity (Poises)	6
Acid Number	35 Max.
Color	Water White
Specific Gravity	1.13
Weight per Gallon (lbs.)	9.4
Stability at 25° C (Uncatalyzed)	6 Mos.
Stability at 25° C (1% Benzoyl Peroxide)	2 - 5 Days
Styrene Compatibility	Infinite

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Liquid decomposition products may or may not be volatilized further by contact with heated surfaces (3). As with TFE, protective masks and adequate ventilation should be provided in application and fusion areas.

Post-fusion treatment

Slow cooling of TFCE at room temperatures results in crystalline, opaque films with high tensile strength, but with poor flexibility and elongation properties. Amorphous, tough, transparent films are obtained by quenching in cold water or cold air. Quenching also helps to prevent stress cracking in complex substrates and at sharp edges. A quenched film is more durable on irregularly shaped objects because it is more extensible. Satisfactory quenching of TFCE is accomplished immediately after the last sintering by quickly immersing substrates in cold water before the temperature of the film falls below 412° F., the critical temperature of the resin. Large objects require spraying or flooding of the film with water and large internally coated vessels are sprayed both inside and outside.

Rapid quenching of TFE films also makes them tougher and more transparent and increases their impermeability to corrosives. Additional improvement of Teflon impermeability is achieved by cold working through rubbing or buffing with fine crocus cloth. Even then, the resulting impermeability is not equal to that of the TFCE coatings. Hot corrosive liquids and vapors, particularly fuming acids, stopped by TFCE, will pass in minute quantities through TFE films.

Obviously, quenching cannot be as rapid in glass and ceramics without cracking the substrates. Sudden quenching is also not practiced with films on copper, copper alloys, and plated metals where the sudden temperature drop could loosen the coating. Thin-gage substrates may warp and buckle because of uneven cooling during quenching.

Quality control

Since both materials and application of fluorocarbon coatings are costly, the coating job should be done right, with minimum loss of resin. Sloppy technique will yield poor results with a great waste of money. Properties of the fused film coating should compare closely with those of the virgin resin. Coating thicknesses should be no less than those specified for various applications by the resin manufacturer. Thick coatings *must* be applied in thin layers.

In TFE coatings, test panel procedures provide accurate control of application techniques. The spray dispersion, thinned with 10 parts of distilled water per 100 parts of dispersion, is applied over primed steel panels. After fusion for 5 min. at 750° F., the surface is examined visually and electrically for continuity and signs of cracking. One-mil coatings should demonstrate 1) no open cracks under normal conditions; 2) no cracks or breaks at 60X magnification which cannot be healed or covered; 3) finish equal to the standard when floated out by a 3.3-mil doctor blade, unreduced, on a glass panel.

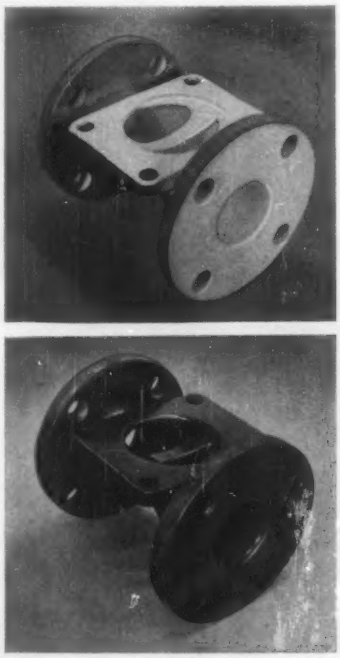

Fig. 8: Air-dried fluorocarbon dispersion coating on a valve body before (top) and after fusing. (Photo, M. W. Kellogg)

Bond strength can be tested on a non-vital portion of the coating. A 1-in. wide strip, separted from the substrate by knife or spatula, should require a force of 10.5 lb. to peel it from aluminum or steel. A test panel is usually prepared for questionable surfaces to test ultimate adhesion to the substrate. A panel of the same material is prepared and masked off to reveal a "bare" section 1 by 4 in., then coated with primer and baked for 5 min. at 750° F. With the mask removed, six coats of clear enamel are applied to the entire panel and each coat fused. One-in. strips are then cut at right angles to the primed area and the clear finish peeled to the edge of the primed area. The load necessary to peel the film off the primed section is then measured with a Scott tester.

An approximate estimate of quality of a coating can also be obtained from the surface texture, which should have a slight orange peel and be waxy to the touch. Rough films usually indicate improper application techniques and that maximum characteristics have not been developed in the fused film. Polyfluoron coatings applied by the Acme system should be smooth and glassy, free from mud cracks and blisters.

The impact resistance of fluorocarbon coatings is indicative of the quality of the material and its application. One test consists of dropping a 3-lb. weight from a measured height onto a ¾-in. steel ball resting on a coated surface. Properly applied TFCE coatings should withstand a 50 in.-lb. force without measurable indentation. A 90 in.-lb. force should be needed to "flow out" the coating over the primed surface (6).

Minute voids or pinholes in the finished coating can be detected by strike-through with a spark rated at 5000 to 10,000 volts. But unless the apparatus is perfectly adjusted, spark testing may impress extremely high and poorly regulated voltages, exceed the dielectric strength, and puncture even a perfect coating.

For electrical testing of TFCE, a megohmmeter that applies a 500-v. d.-c. potential across the

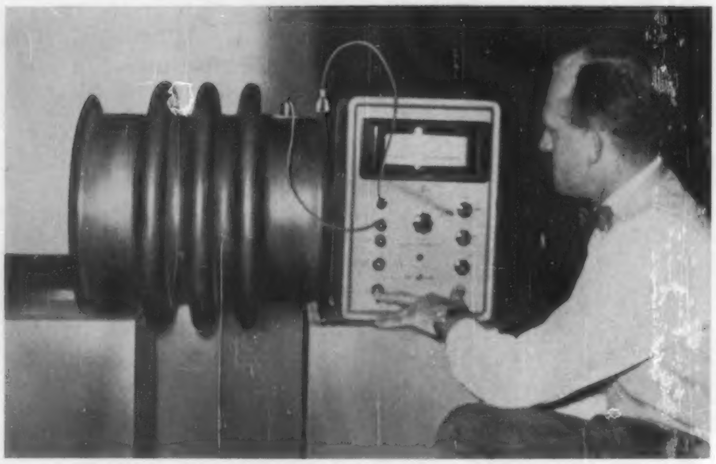

Fig. 9: Testing for porosity in fused fluorocarbon film, using electrical-resistance test and a 500-v. megohmmeter. Right lead is ground, left rests on movable pad. (Photo, M. W. Kellogg Co.)

coating is recommended. With the substrate grounded, a pad saturated with 1% saline-wetting agent solution is used with the test lead (Fig. 9). A sound coating shows no permanent negative deflection (5).

With TFCE it is desirable to check on the molecular weight of the coating, using a solution-viscosity test. An actual strip of coating tested should have a minimum solution viscosity of 0.99 centistokes (by M. W. Kellogg 50-1, using an 0.75% solution of Kel-F in 2,5-dichlorobenzotrifluoride at 266° F.).

As an aid to standardization of coatings, the ultimate user should define specifications for each coating job. Typical specifications could cover: 1) Coating thickness and allowable variations; 2) Texture of fused film; 3) Appearance; 4) Allowable discontinuities; 5) Electrical resistance testing (10^6 megohm is minimum for Kel-F); 6) In extremely demanding applications, solution viscosities (TFCE) or an equivalent measure of material quality; 7) Adhesion: TFCE should show no peeling, etc., after 48 hr. at 240° F.

Other coating techniques

Pressure and suction spray techniques are by far the most widely used in the application of fluorocarbon coatings. But dip-coating, spread-coating, and brushing are used in treating a wide variety of metallic and nonmetallic substrates.

Dip- or flow-coating: Small objects, flat panels, wire and small diameter tubing, which are impractical to spray due to excessive spray losses, as well as objects whose surfaces are inaccessible to spray equipment, are readily coated by this method. Metal foil, glass and asbestos cloth, and the plies of fluorocarbon glass-fiber laminates are examples.

TFCE dispersions (Kellogg N-2), are supplied at high viscosities for flow-coating and spread-coating procedures. These are thinned to about 35% solids content with amyl acetate or the more volatile acetone for flat surfaces, and to a lower solids content for more complex surfaces. Coatings of approximately 2 to 4 mils (fused basis) can be applied. Thickness is a function of the rate of removal from the dip dispersion, with thicker films deposited at fast withdrawal rates, depending on viscosity. Withdrawal rates must be low enough so that the wet film does not sag. In closed or partially open constructions, proper drainage must be provided to prevent retention of dispersion in excess of its critical thickness. Objects with one end closed are coated by filling with dispersion, then inverting to drain. Spray equipment can also be utilized to force dispersion up into chambers which can not be coated by the dip-and-drain method. The drying and fusion of dip coatings is the same as for spray coatings.

A special Teflon 30 aqueous dispersion is used for dip coating of surfaces as well as for casting films for making diaphragms and gaskets. A prominent use is the production coating of magnet wire with black enamel. Dispersion concentrations of 45 to 50% solids by weight and 9 to 12% wetting agent (solids basis) are recommended (supplied as 60% solids content) (8).

Thickness of individual coats deposited in each dip is limited to 1 mil per fusion to prevent mud-cracking and to permit volatilization of the dispersing agent during fusion. Since dip preparations when laid down have a tendency to retain air bubbles, precautions should be taken to remove all such bubbles before drying and fusion. Bubbling can be reduced by adding up to 20% distilled water.

On a continuous production line—for example in the coating of glass fabric—coating thickness is regulated by the use of an air jet as a doctor knife. Drying prior to fusion is accomplished at room temperature in from 15 to 120 sec. per mil, or more rapidly under infra-red lamps or in forced-convection air ovens. During fusion at 680 to 750° F., wetting agents are volatilized and discrete Teflon particles are sintered into film simultaneously within 3 to 8 min. per mil.

In casting film, molds of polished alloy or chrome-plated steel are coated, dried, and fused as in other methods described. To promote easy stripping, rapid quenching is essential.

A variety of porous structures as well as gasket and braid materials can be readily impregnated with TFE. Coating thickness is regulated by the irregularity or discontinuity of the surface, with multiple dips and baking to provide heavy coatings with good homogeneity. In some cases, TFE deposits may not have to be sintered; for example, in those applications where only water-re-

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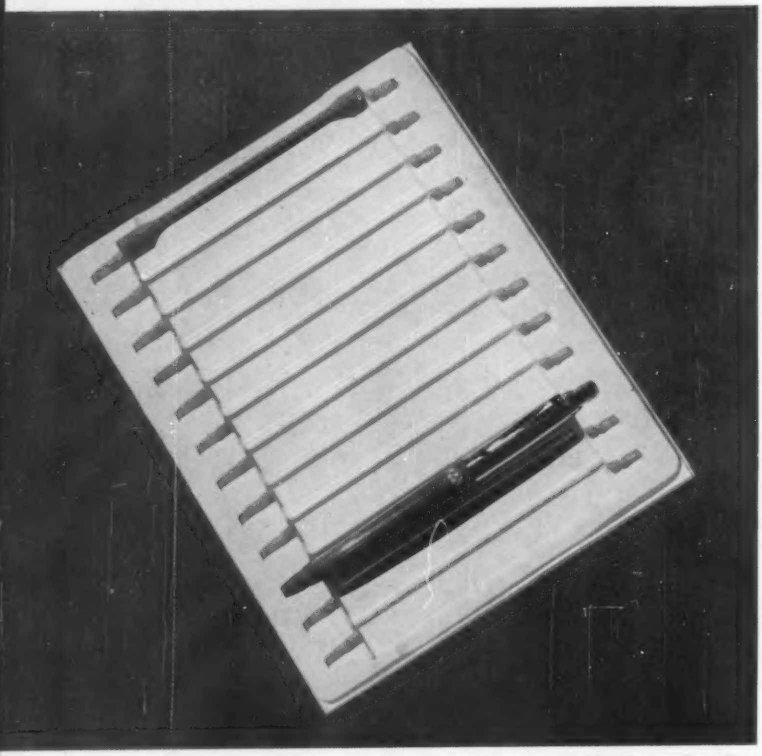


Trays for PARKER Jotters formed by **Janesville Paper Box Co.,** Janesville, Wis., from sheets extruded by **Midwest Plastic Products,** Chicago, Ill.

For show and for safety—trays vacuum-formed from impact styrene sheets

This tray has grooves vacuum-formed to such a precise fit that they hold every pen firmly in place. It keeps the pens safe in shipment. For display, the tray is quickly slipped into the display case—the pens stay neatly in order. The sheet of BAKELITE Brand Impact Styrene TGD-5001 White 195 makes a superb background for the colored pen barrels. The smooth, easy-to-clean finish keeps its fresh appearance.

Products vacuum-formed from extruded sheets of BAKELITE Impact Styrene TGD-5001 have ranged in sizes up to refrigerator door liners measuring 26 in. by 49 in., and they all possess the same advantages—toughness, excellent appearance, accurately-formed details. This material is ideally suited to the vacuum-forming process because it can be extruded into sheets that retain their gloss and toughness after forming. Color range is practically unlimited.

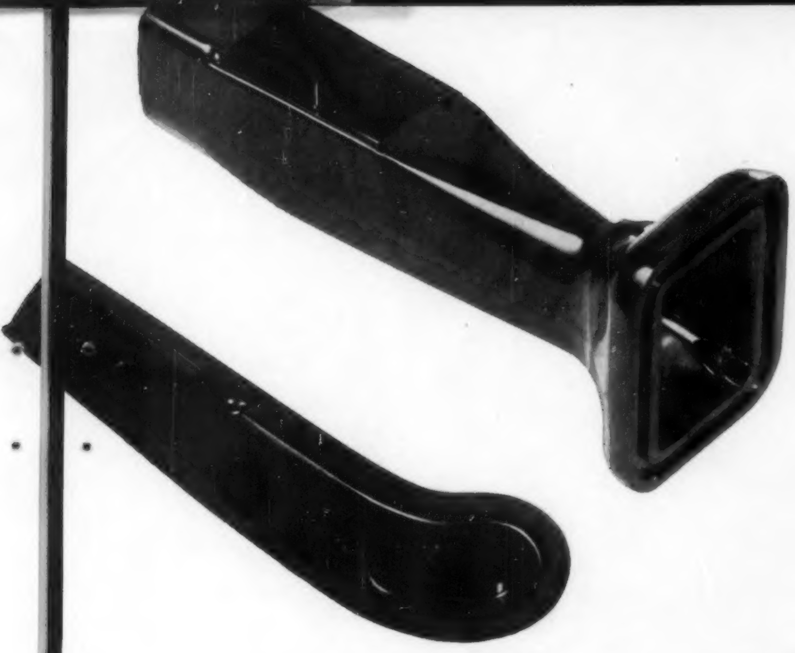
Detergent can has polyethylene spout for fast assembly, clean appearance

This spout molded from BAKELITE Brand Polyethylene tops off a metal container for liquid detergent. There are two good reasons why . . . its inherent flexibility permits assembly-line attachment, and its chemical resistance assures good appearance and proper operation without danger of corrosion.

BAKELITE Polyethylene's uniform shrinkage approaches a tolerance of ± .004 in. in molding, so that the spouts can be successfully pressure-fitted at high speeds. Their inherent resilience prevents damage to the enameled metal.

They are molded in molds containing up to 20 cavities. Each charge averages 40 seconds. Careful control of molding variables has resulted in high stress-cracking resistance and elimination of skinning.

Polyethylene pouring spout molded by **Mack Molding Co.,** Arlington, Vt., **Polymold Plastics, Inc.,** Chicago, Ill.; and Millsplastic Division, **Continental Can Co.,** Chicago, Ill.



Cooking utensil handles demonstrate heat resistance and good appearance of BMG-8335 phenolic

For almost ten years, the manufacturer has used the same BAKELITE Brand Phenolic for these cooking utensil handles—striking evidence of this molding material's satisfactory service.

BMG-8335 Black 35 is a mineral-filled, two-step phenolic of relatively low specific gravity, possessing exceptionally good heat resistance. In this application, it has withstood exposure to 450 deg. F. for three hours, but it will take temperatures up to 500 deg. F. for shorter periods. Pieces molded from BMG-8335 have a high surface gloss and exhibit outstanding color retention after exposure to high temperatures. As a result of these superior service properties, it is widely used for utensil handles and components for heating appliances.

Cooking utensil handles molded by **Auburn Button Works,** Auburn, N. Y.

Molded styrene flower pots match the beauty of their contents

A striking range of colors + design features, impossible with clay pots, is evident in these pots and planters molded from BAKELITE Brand General-Purpose Styrene SMD-3500. They come in 14 different styles and 22 sizes, several combined with saucers molded from the same material.

Besides having these obvious selling advantages, the pots are constructed for maximum efficiency. Their bases are perforated to insure proper drainage. Those with saucers also permit oxygen circulation, since they are elevated on molded-in supports. Uniform shrinkage of SMD-3500 provides the close tolerances needed for pressure-fitting these pots to their trays.

Since the pots are not porous, they do not discolor. Surfaces are smooth and glossy, unaffected by most gardening substances.

Flower pots and planters molded by **Quality Molding Company,** Chicago, Illinois.

One plastics source...

PHENOLICS
STYRENES
IMPACT STYRENES
POLYETHYLENES
VINYLS
POLYESTERS
EPOXIES

BAKELITE BRAND **PLASTICS**

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

sion, **Continental Can Co.,** Chicago, Ill.

pellency or anti-hesion properties are required.

An equally wide range of dip-coating applications are possible with Polyfluoron adjusted to proper viscosity with methyl isobutyl ketone. Dispersions of 33% are specified for "slow" withdrawal rates, 25 to 30% for "fast" withdrawal to obtain optimum film thickness. Production-line coating of wire (5 mils) proceeds at 20 to 25 ft./min. followed by continuous fusion at 650° F. in gradient ovens (9).

Fibrous glass fabrics are coated by a multiple-dip method similar to that widely used in production-line coating of magnet wire. The method, however, is limited to narrow widths.

Spread coating

High-viscosity TFCE spread-coating dispersions are used in treating glass cloth and other high-temperature fabrics by doctor-blade techniques (Fig. 10). These techniques are adaptable to production line methods with coating thicknesses controlled by properly regulated doctor blades, usually to a thickness of 2 to 3 mils per pass. Because of the high melt viscosity of the resins, baking time is reduced from hours to minutes by the application of 500 to 1000 p.s.i. through heated rolls or platens to fuse the air-dried coating. In contrast to spray or dip coating, only the final coat is fused.

Because of the critical thickness characteristic of TFE materials, spread coating is limited to flat, relatively rigid surfaces. Incremental thicknesses are limited to a maximum of 1 mil, to lessen the likelihood of incomplete sintering as well as a deficient fused coating.

Brush coating

The thixotropic nature of TFCE dispersions prevents wide-spread use of the brush-coating method. Inconsistent results are obtained, since undesirable brush marks are produced which do not level off. Small objects are brush-coated by Polyfluoron applicators, then are almost immediately vibrated to encourage flow-out of brush marks before drying. Lack of thickness uniformity is a drawback so far as certainty of protection is concerned.

Because TFE particles used in coating dispersions have a tendency to coagulate on mechanical working, brushing them on is not practical except with small objects.

Repair of coatings

As with standard organic and inorganic finishes, methods are available for repair of fluorocarbon coatings. The finished repair is equally as good as the undamaged coating. Repair procedures are used to touch up scratches and pits caused by service conditions or bare spots occurring during the original coating operation.

If the break is widespread, i.e., if it covers a significant percentage of the total surface, the best solution is to burn off the entire fused coating and start from the beginning.

When pinholes or relatively small imperfections must be repaired in TFE coatings, a generous area is stripped or sandblasted away (after proper masking) and recoated using standard TFE procedures, including the application of primer. The patch is "feathered-out" as gradually as possible so that its thickness will be the same as that of the rest of the coating. Drying and fusion of repair coatings can be done with localized sources of heat such as infra-red lamps, induction heating, and oxy-acetylene torches.

In TFCE systems, several repair methods are available. Beside the "clean-spray-dry-bake" procedures, three other repair methods, taking advantage of the resins' peculiar properties, are available. One depends on a duplication of the original coating procedure. Then, before fusion, a film of Teflon is placed over the "patch," held in place by permanent magnets, and fused (10).

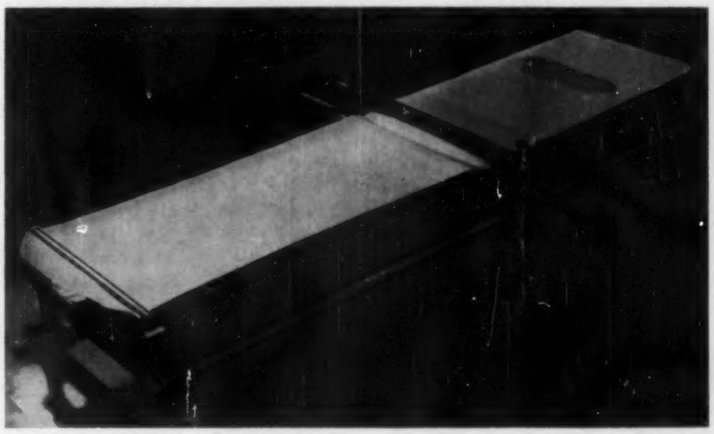
TFCE resins are true thermoplastics, so defective areas can be patched, without baring the substrate, by heat-sealing a section of cast film directly over the defective area. Either RF equipment or a special "hot iron" appliance protected by metal foil, can be used. Lower power factor prevents the RF method from being used in the case of Teflon repair.

Another method is to strip away an area larger than the affected spot, applying a TFCE fibrous glass laminate directly to the substrate with an epoxy or other high-temperature adhesive. The exposed edges of the laminate patch are then heat-sealed to the fused coating.

Economical repair of imperfections by the "dispersion method" can be realized by using an artist's brush or "touch-up" spray gun. Repair of Polyfluoron coatings is made convenient by the

(*To page* 241)

Fig. 10: Heat-cleaned glass cloth being spread- or doctor-coated with high-viscosity fluorocarbon dispersion. Subsequent fusion will be done with heated pressure rolls. (Photo, The M. W. Kellogg Co.)



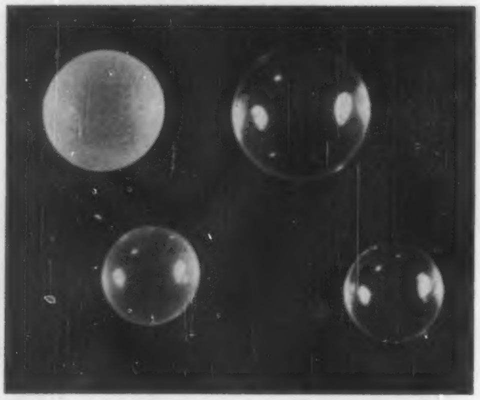


Fig. 1: Eye inserts for artificial eyes. Upper left: before processing; upper right: after polishing; lower left: after fine-finishing; lower right: after polishing. (All photos, Lord Chemical Corp.)

Fig. 2: Although they are made of various plastics, these buttons have all been polished by the same method, viz., barrel finishing

Precision finishing by tumbling

By William E. Brandt†

Tumbling barrels can handle economically a wide variety of plastics finishing problems, from simple deflashing to attaining a glassy sheen. A quick look is taken at the questions: What kinds of actions go on in a tumbling barrel? How do they depend on barrel speed and size? The potentialities of available equipment and media—or tumbling aids—are discussed, along with the relative effectiveness of the different methods of deflashing, finishing, and polishing. Typical barrel sizes, loads, speeds, and cycles for plastics parts are given. Other topics covered include care and maintenance of tumbling media, and recommended auxiliary equipment.

The removal of flash or burrs from molded plastic parts can be accomplished on an economical, mass-production basis by tumbling. Tumbling barrels may also be used to impart a precision finish, to radius edges, and to polish to any specified luster (see Fig. 1, above).

Most plastics, thermosetting and thermoplastic, can be successfully tumbled. The process can be applied to parts that have been previously cast, injection molded, compression molded, extruded, or machined. Though barrel-finishing methods are especially applicable to small parts (Fig. 2, above), larger pieces are often finished by this process. Even such large items as radio cabinets and instrument housings can be barrel-tumbled.

The large number of plastic compositions—to say nothing of the wide variety of shapes and sizes of plastic parts—makes it impractical to give specific directions for tumbling in this brief article. In general, the jobs to be done by the tumbling barrel may be divided into three broad and often overlapping categories: 1) the removal of flash and burrs, 2) finishing, and 3) polishing.

Many plastic parts must undergo all three of these steps. Others need only one. Some parts, especially those manufactured by injection molding, may need no further processing. To a lesser extent, this may also be true of parts made by compression molding. However, many compression moldings require finishing.

How tumbling works

All three tumbling categories involve basically the same processes. Two actions—impact and abrasion—are involved, one or the other usually being the more important. In wire-mesh deflashing, for example, impact predominates. Both actions, which go on during the "slide," get their energy to do their work by the lifting action of the rotating barrel. If the barrel were rotated about a *vertical* axis, there would be no lifting action, almost no tumbling, and, very likely, no finishing, either. Most barrels, therefore, are rotated around a horizontal axis or one tilted at a small angle from the horizontal. Because there is a certain amount of friction and mechanical bridging of the barrel's solid contents, along with a centrifugal force of

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rotation tending to hold the pieces against the barrel wall, the pieces on the rising side are lifted above the general level until their weight overcomes these lifting factors and they tumble downward toward the center. The energy they dissipate during their fall, their shapes, and their mechanical properties determine the rates at which vulnerable sections are broken off and abraded.

Considering the centrifugal lift factor alone, and assuming the barrel to be half full of solids (a common operating condition), the lift energy that a particle gets is proportional to the square of the rotational speed (r.p.m.) and to the square of the diameter of the barrel. Eventually, of course, if the speed were increased enough, particles at the barrel surface would be carried over without falling at all, and they would contribute nothing to the tumbling action. Particles nearer the center would still fall, however, and would not be carried over until the speed was increased even more. Aside from the loss of efficiency at carry-over speeds (roughly 54 r.p.m. for a 24-in. barrel, 44 r.p.m. for a 36-in. barrel), the large drop energies imparted to the falling particles at such high speeds might be higher than wanted, particularly with dense particles. In most dry tumbling, considerably lower speeds are used.

Since the centrifugal lift is also proportional to the square of the barrel diameter, larger barrels must be rotated more slowly than smaller barrels if they are to deliver the same impact energy to the particles. These two square laws, though they do not take into account the role of bridging in the process, provide at least a rough guide in scaling up test results from small test barrels to larger production models when other conditions are kept the same.

Much tumbling is done with the aid of added "media"—abrasive chips, particles of high density that provide heavier impact, or abrasive-carrying vehicles. Some tumbling is done without added media, and depends for its effect on impacts and abrasions between the articles being finished. In some cases, the sides of the barrel help in the process. Such pieces are said to be "self-tumbled."

Fig. 3: Fused aluminum oxide chips come in 17 size ranges; these are No. 2, 5/8 to 3/4 inch

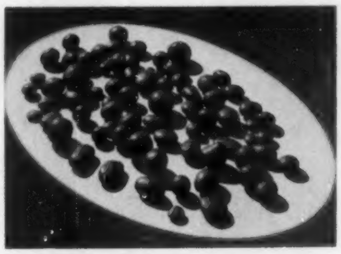


Fig. 4: Fine-finishing balls, available in sizes up to 2 in., are made of wax and fine abrasives

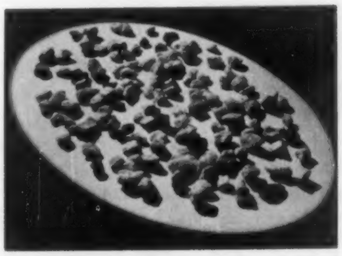


Fig. 5: Pumice granules are faster but will not produce as smooth a finish as the waxy balls

Suitable shapes

A wide variety of shapes are suited to the tumbling process. In general, projecting sharp edges and corners will be broken off, worn away, or rounded by the tumbling action. It is this action that accomplishes the desired deflashing. If sharp edges are "hidden" or protected by nearby convexities, and if large enough media are used, such edges may come through the operation unmarred. On the other hand, to remove flash by tumbling may cause unwanted rounding of sharp edges situated symmetrically to the flash line. As an example, consider a molded disk in which the flash is in the plane of one of the disk's faces and extends beyond the nominal diameter. Tumbling to remove the flash will also, to some degree, round the other circular edge of the disk. Where the sharpness of edges *must* be preserved, and where some deburring must be done, it is advisable to make test tumblings of the part under several sets of conditions to find those conditions that will best remove the burrs without rounding the other edges. On larger pieces, where it may be economical to do so, a small vulnerable area that it is desired not to alter may be protected with a strippable elastomeric coating.

Deflashing and deburring

Self-tumbling in wire barrels. Deflashing in barrels made of wire mesh is the simplest and cheapest method, but it is applicable only when the flash is not too heavy. Generally, flash can be successfully removed in the wire-mesh barrel if it can be easily broken off by hand. The screens may be of various sizes. Closer-meshed wire gives finer deflashing, but the mesh opening must be large enough for the flash to fall through. An accumulation of flash will damage the load.

Normally, a 50% total load is satisfactory. When workpieces contain much flash, the total load will have to be higher in order to obtain more working pressure.

Like all tumbling barrels, the open-mesh barrel should be equipped with a variable-speed drive. The speed of a particular run—usually between 16 and 30 r.p.m. in 30-in. barrels—will depend on the nature of the part and the diameter of the barrel. It is often advisable to run faster at the beginning and slow down as the load decreases in height. The usual time cycle is between 0.5 and 1.5 hours. Longer cycles are seldom necessary, since if the flash is not removed in an hour and a half, it generally will not be removed in a longer cycle.

Smooth blocks of wood in suit-

able sizes may be added to the load to assist in the removal of excessively heavy flash lines. Wooden blocks will also help to make up the required weight of load when there is a shortage of workpieces.

Should the deflashing process be followed by a finishing run (see discussion under "Finishing" below), the parts must be thoroughly washed in water containing a detergent. Mere cleaning with compressed air is insufficient. After washing, the parts must be thoroughly dried, preferably in a centrifugal drier. Any moisture on the parts in a finishing or polishing run can be disastrous, resulting in non-uniform, rough surfaces.

Wet self-tumbling. Self-tumbling in a wire-mesh barrel, though simple and economical, is limited to the removal of coarse flash. For final removal of flash lines or for deburring, wet self-tumbling with a tumbling compound may be the answer, especially if the workpieces are of sufficient size, weight and density.

Regular production-type barrels with rubber-lined steel drums are quite suitable. Wooden barrels may also be used if they are at least 30 in. in diameter. In loading, the compartment is filled with workpieces to between 50 and 70% of the total volume; then water is added to a level of 2 in. above the mass. A few ounces of either a detergent or a non-abrasive deburring compound are added, depending on the nature of the part. The load is run for 30 to 45 min. at a speed suitable to the workpieces. If the flash or burr is not removed within this period, a longer time cycle will seldom help. Some other deburring method is indicated. After tumbling, the parts are dried, preferably by hot air or in a centrifugal drier, before polishing.

Wet tumbling with fused aluminum-oxide chips. This is a most satisfactory method of deflashing and deburring for both thermosetting and thermoplastic materials. It can be successfully applied to parts made of phenol-formaldehyde resins[1], urea-formaldehyde resins, acrylics, cellulosics, cast phenolics, and others. Asbestos-filled and rag-filled materials are also satisfactorily deflashed by this method.

Equipment and chips are identical with those used to tumble metal parts. Regular neoprene-lined production barrels are employed. The advantage of the method lies in the fact that the fused aluminum-oxide chips (Fig. 3, p. 151) will act with precision on plastics suitable for the method. Edges can be radiused according to specifications, flash lines and burrs can be successfully removed, and surfaces can be greatly improved. The results obtained are vastly different from those yielded by the previously described methods, which can only remove flash and perhaps grind down the edges.

The nature of any grooves, openings, slots, etc., in the workpieces dictate the chip size; 17 sizes from #16 grit to 1.8 in. are available. Wedging in the openings must be avoided at all costs. Often, one size of chip, either too large or too small to wedge, will do the job. A larger chip will create a larger radius and produce a coarser finish than a smaller chip. Sometimes, by mixing a smaller chip with a larger one, both radii and finish can be controlled while the smaller chip will also work the grooves and slots.

The compound may be either the same non-abrasive deburring compound used in wet self-tumbling or a burnishing compound. Sometimes a very-fine abrasive-type compound may be used. Such compounds will brighten as well as cushion parts during processing.

The proportion of chips to work depends entirely on the nature of the workpieces and the changes to be wrought in them. For some pieces, equal proportions are used, while for others the proportion of chips to parts may vary up to as high as 7 to 1. Normally, the best and fastest action is obtained if chips and workpieces together make up approximately 55% of the total barrel volume. However, the compartment may be loaded anywhere from 50% to as high as 70 or even 75%. In this type of barrel tumbling, it is important that the mass be covered by about 2 in. of water.

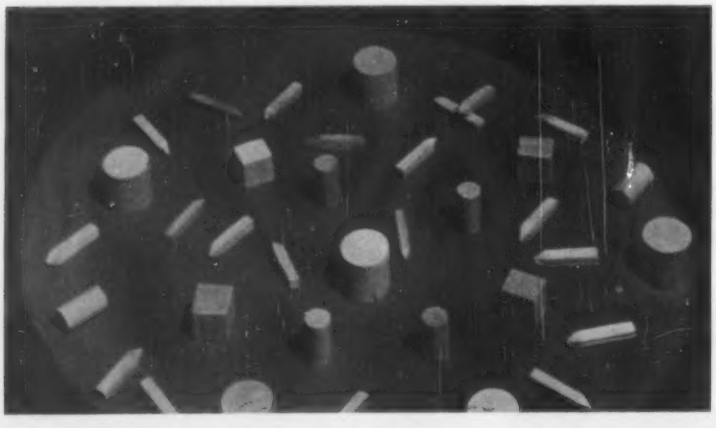
After unloading, the parts should be rinsed and put through the centrifugal drier. Drying with a fair amount of heat will enhance polish and color.

Steel pins, balls, or shot. These are used when workpieces have shielded areas which cannot otherwise be reached or small openings that must be deburred. With these media alone, the action is entirely by impact. Balls and pins of sizes unable to wedge in the work should be chosen. The ratio of media to work should be somewhere between 2:1 and 6:1.

Barrels with regular rubber-lined compartments can be used, and deburring may be done either dry or wet. Wet deburring is preferable because of the cushioning provided by the water, which should cover the mass by about

[1]When phenolic moldings are run by this procedure, care must be taken not to penetrate the pressed skin; this finish cannot be restored. Usually such pieces cannot stand a run longer than 30 to 45 minutes.

Fig. 6: Mixed media for polishing plastics, consisting of hardwood cubes, dowels, and pegs in a range of assorted sizes



2 inches. Either a deburring or a burnishing compound should be used, as recommended for other types of wet tumbling. The burnishing compounds contain no abrasives but cushion the impacts of the pins and balls. As in the previous operations, the parts must be thoroughly rinsed and dried before they are placed in the polishing barrel.

Finishing

Many plastic parts need surface grinding in addition to deflashing and deburring. Finishing balls (Fig. 4, p. 151) and pumice granules (Fig. 5, p. 151) have been developed for this purpose. These media generally provide a gentler action than the aluminum-oxide chips, which may also be used for finishing. The action with the pumice granules is very much faster than with the finishing balls, which are made of special waxes and very fine abrasives, but the balls will produce a smoother finish.

Tumbling with finishing balls is done dry in a simple wooden barrel, running at slow speed. Barrel diameter should not be less than 22 to 24 inches. The balls have been used to finish a wide variety of thermosetting and thermoplastic materials. They can be obtained in six sizes between ¼ in. and 2 inches. The ½-in. and ¼-in. balls are often mixed in equal quantities with very satisfactory results.

Temperature may be a critical factor when finishing balls are used. If the barrel is run too fast, the heat of friction can melt the waxy balls so that they stick together. In hot weather it is sometimes advisable to replace the usual solid lid of the barrel with a wire-mesh lid that will allow air to enter the compartment and cool the contents.

Having completed their run, the finishing balls can be used for a further load of work without treatment. This is not true of the pumice granules, which must be dressed with a special oil after each run.

Redressing, done after each work run, requires about 2 fl. oz. of oil to every 56 lb. of granules, but the amount of dressing may be slightly increased if a large number of workpieces are being processed. After the dressing oil has been poured into the barrel compartment, the granules should be run by themselves for about 30 min. before the workpieces are added. The granules should feel damp, but not wet, when the proper state for finishing has been attained.

Pumice granules are available in ¼-, ½-, and ¾-in. sizes. They provide inexpensive processing if equipment for better procedures (e.g., wet tumbling with aluminum-oxide chips) is barred for cost reasons. As compared to finishing balls, they reduce the time required from 8 to 6 hours.

Fig. 7: Wood media for polishing plastics must be dressed with a warm mixture of cream and solvent

A simple wooden barrel is used, as with finishing balls. The compartment is filled to about 70% of its total volume. The ratio of pumice granules to workpieces is normally 4:1, but may change considerably according to the nature of the work.

Finishing granules are often used on such parts as buttons and eyeglass frames. They are also useful for giving a matte finish to prevent glare on such parts as key tabs for business machines.

Polishing

While there are a variety of methods for deflashing, deburring, and grinding or surface finishing, the polishing process is the same for almost all plastic parts. A specially developed cream (such as Lorco No. 10) imparts to plastic surfaces a high luster that remains permanent.

The polishing barrel should be airtight, with a hardwood liner and, preferably, a minimum diameter of 30 inches. Polishing speeds usually run from 32 to 38 r.p.m.

A wooden carrier for the polishing cream is required. Hardwood shoe-pegs, dowels, or cubes (Fig. 6, p. 152), or suitable mixtures thereof in various sizes, are used. Again, it is important to choose sizes that cannot wedge. The surfaces of the wooden cubes, pegs, or dowels must be absolutely smooth. To prepare new, unused media for proper service, they should be rotated in a wire-mesh barrel for several hours. Care must be taken to see that these media are wholly free from dust before they go into the polishing barrel. The chamber of the wooden barrel must also be cleaned of dust and extraneous matter before receiving the media.

As was pointed out earlier, the workpieces must likewise be free of dust or dirt. Wet-tumbled parts must be rinsed and thoroughly dried. Articles previously processed dry in a wire-mesh barrel or with finishing granules must be washed and dried before they are allowed to enter the polishing barrel. However, parts processed with finishing balls may not contain any dust and, after inspection, can go directly to the polishing barrel without washing.

New media must be impregnated with cream before a polishing run (Fig. 7, p. 154). A barrel compartment measuring approximately 16 in. long by 30 in. in diameter should hold around 56 to 60 lb. of cubes, pegs, or dowels when filled just over the half-full mark. For this load, 1.5 lb. of polishing cream should be melted down in a hot-water bath. While this is being done, 6 fl. oz. of dipentene thinner (inflammable) should be heated in the same bath. The melted cream is poured into the heated thinner, and the stirred mixture is quickly poured as evenly as possible over the media in the barrel. The solid lid

Fig. 8: Compression molded phenolic handle was taken from polishing barrel and shows "bloom" which forms during processing and can be seen on right side; left side is wiped clean

Fig. 9: Compression molded phenolic appliance handle after polishing. Note the extremely high luster

is then attached and the barrel rotated.[2] When new media are to be impregnated in a new barrel, proportionately more cream and thinner will be needed to allow for impregnation of the sides of the barrel also. The impregnation process should take several hours when both barrel and media are to be impregnated and should under no circumstances be less than 30 minutes.

After impregnation is complete, workpieces are added to fill the compartment to ⅔ capacity. The barrel is then rotated at about 34 r.p.m. for a time lasting from 6 to 10 hours.

If the lid is opened after the load has been running for several hours, it will be found that the workpieces are covered with a "bloom" (see Fig. 8, above). This is the correct condition. The barrel should never be opened too long for inspection since the heat of friction, which is essential to the polishing process, will be lost. The lid should be opened quickly, and a workpiece extracted and wiped with a cloth. If a high luster appears beneath the bloom, the part is polished. The solid lid is then replaced with a wire-mesh or perforated lid, and the barrel is run an additional hour to permit the thinner to evaporate. During this part of the run, the bloom is re-absorbed by the media so that no polishing cream whatever remains on the finished parts (Fig. 9, left).

The impregnated media may be used for 15 to 20 runs. However, some polishing cream and synthetic thinner—usually between 2 and 4 oz. of cream to about 1.5 or 2 oz. of thinner—must be added before each run. The melted cream and thinner must be poured over the media and never, under any circumstances, over the workpieces.

The polishing times of the various plastics differ considerably, depending also on the initial condition of the surfaces to be polished. To cite a comparison, a phenolic piece that is taken directly from the mold and deflashed in a wire-mesh barrel will polish very much faster than a machined methacrylate piece that shows tool marks. The surface of the phenolic piece has not been greatly disturbed by previous operations, whereas the methacrylate part must have its surfaces refined.

Maintenance and life of media

In spite of the fact that it is subjected to a great deal of impact and rubbing, the wire mesh used in self-tumbling barrels for deflashing and deburring seems to have almost indefinite life. Some wire-mesh barrels have been used daily for more than 11 years with the original wire.

The fused aluminum-oxide chips are very nearly an all-purpose tumbling medium. Properly cared for, they will serve for a very long time. Chips that look clean but feel slippery may have their pores loaded with plastic and grinding-compound refuse. Such chips will peen and can be used for burnishing, but they will never cut. To clean the chips, cover them with water in the tumbling barrel and add a few ounces of a good detergent. Run the load for 5 min., drain, and rinse with fresh water. The rinsed chips will be sharp.

Steel balls, pins, and shot should be rinsed free of tumbling refuse and dried completely to prevent their rusting in storage.

The pumice granules used for finishing will, after 15 to 20 runs, have accumulated a large amount of material from the workpieces. At this point, they should be removed from the barrel and soaked in water with a small amount of detergent. The finishing compound and foreign material will emulsify and soak off from the pumice. After a thorough drying, the granules can be returned to the barrel. They must, of course, be redressed before the work load is added.

The wooden polishing media, like the pumice granules, must be cleaned after 20 to 25 runs. This is done by placing them in a wire basket that is suspended in trichloroethylene vapor for 10 minutes. They can also be cleaned by washing with a detergent, but care must be taken in drying not to get them too hot. If steam forms within the wood fibers they will burst and the media will become rough and splintery—and therefore useless. Either of these cleaning procedures will remove all wax remnants. However, very fine abrasive, which is part of the polish, will remain. To get rid of it, the media must be tumbled in a wire-mesh barrel and then blown off with compressed air.

Recommended equipment

Aside from the production-line tumbling barrels, media, and an assortment of tumbling compounds, a well-set-up tumbling facility needs bins for cleanly storing the different media, a centrifugal drier, some weighing and volumetric equipment, and a 1- or 2-ton hoist with good-sized loading pans. The hoist should serve the whole area. Where many different types of materials and work are processed, it is advisable to have at least one bench-type experimental barrel in which test tumblings can be made before committing a whole batch to a given procedure. Where a long production run is to be made, the equipment maker will often help with the testing.

[2]When working with this or other volatile, inflammable solvents it is advisable to have the barrel grounded to prevent fires due to build-up of static charge.

Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Plastisol viscosity-temperature characteristics

By W. D. Todd,† *D. Esarove,*† *and W. M. Smith*†

It is well known that temperature has a profound effect on the viscosity of vinyl dispersions. In the past few years this viscosity-temperature relationship has assumed increasing importance because of the many and varied processes that require gel temperature and rate information.

A method is described for measuring the apparent viscosity of a plastisol continuously as the temperature varies. This technique will find direct use in applications such as slush and rotational molding in which the point and rate of gelation are extremely important in producing a desirable product. The new and rapidly growing field of expanded vinyl products will provide still another application as will the even newer area of plastisol hot spraying.

Curves depicting these characteristics provide a means of analysis and assist in the proper selection of ingredients and operating conditions.

Dispersions of vinyl polymers in non-aqueous liquids are known as vinyl pastes. These materials, ranging from water-thin fluids to putty-like gels, have grown greatly in commercial importance over the last ten years because of their versatility in application and their useful end properties. They can be easily applied as liquids and subsequently converted to solids by simple heat treatment. A diagram of the four major types of vinyl polymer pastes is shown in Fig. 1, right.

The most common of these dispersions—the plastisols—are systems in which the liquid phase consists solely of a plasticizer.

The plasticizers used for plastisols are poor solvents at room temperature, but when a plastisol is heated, the polymer particles swell (absorb plasticizer) and gelation occurs. Final stages of solvation with the development of ultimate physical properties take place in the region of 175° C. Even without a temperature change, there is a degree of viscosity increase due to increasing resin solvation with time. Most of this happens during the first 24 hours. The important fact is that both time and temperature have an influence on viscosity and that it is virtually impossible to separate their effects.

* Reg. U. S. Pat. Off.

This article is based on a paper delivered at the Southern California S.P.E. meeting on Apr. 5, 1956.

†B. F. Goodrich Chemical Co.

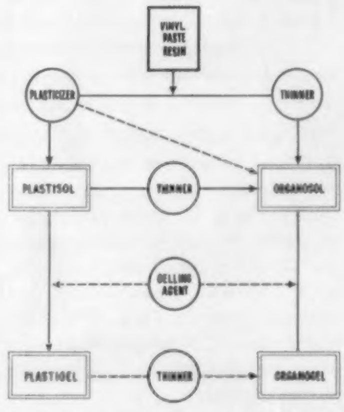


Fig. 1: Relationship of four types of vinyl pastes

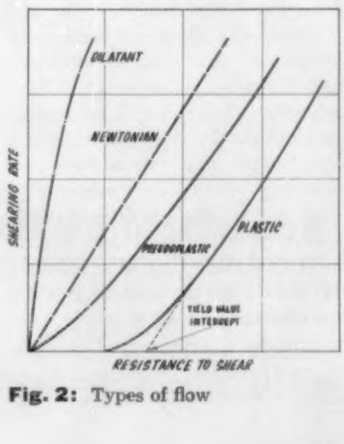


Fig. 2: Types of flow

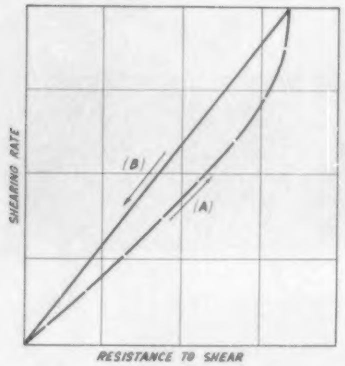


Fig. 3: Curve representing flow that is thixotropic in nature

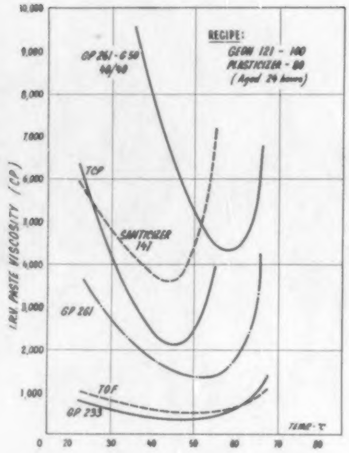


Fig. 5: Effect of plasticizer type on plastisol viscosity

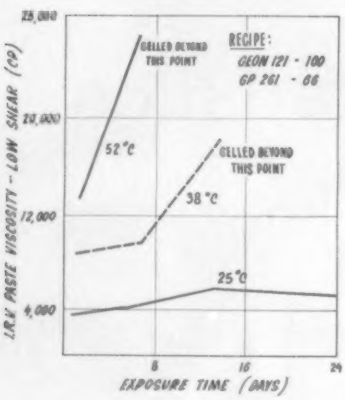


Fig. 4: Change of viscosity on aging at different temperatures

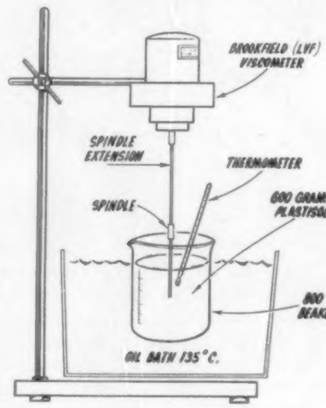


Fig. 6: Equipment used in viscosity-temperature investigation

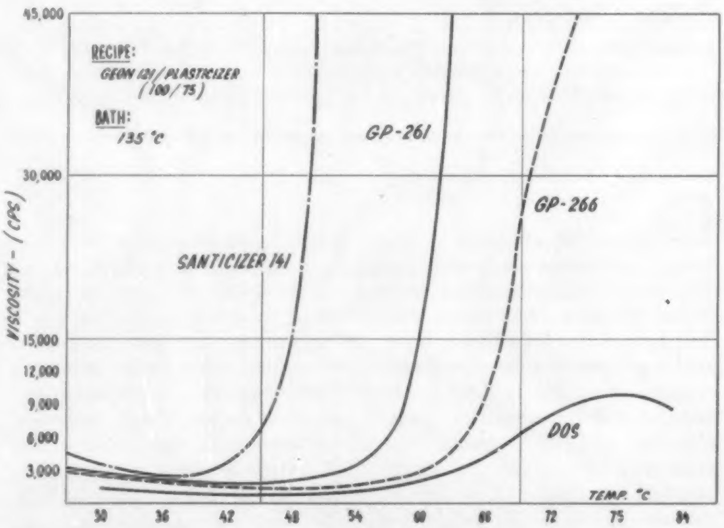


Fig. 7: Effect of primary plasticizers on viscosity

It was early recognized that the flow properties of plastisols are almost always non-Newtonian; that is, their resistance to shear is not proportional to the shearing speed at all rates of shear. Various types of flow are characterized in Figs. 2, p. 159, and 3, above. Most plastisols exhibit thixotropy and dilatancy simultaneously.

Before reviewing the types of instruments that have been used in studying the flow properties of pastes, it should be pointed out that no one viscometer has been developed to solve all flow problems.

Since the flow properties of plastisols are non-Newtonian, and therefore different at different rates of shear, it is necessary to measure the flow properties of low shear applications at low shearing speeds and conversely, high shear applications at high speed, if valid conclusions are to be drawn. Both the Mac Micheal (1)[1] and the Brookfield can be considered as low shearing rate viscometers while the Precision Interchemical Rotational Viscometer (I.R.V.) (2) may be classed as one of intermediate shearing rate. The Severs Extrusion Rheometer (3) measures viscosities at high shear rates. Of the three, the Brookfield is probably most widely used for plastisol viscosity measurements. "Correction" equations have been recently proposed to make Brookfield readings more mean-

[1]Numbers in parentheses link to references at end of article, p. 174.

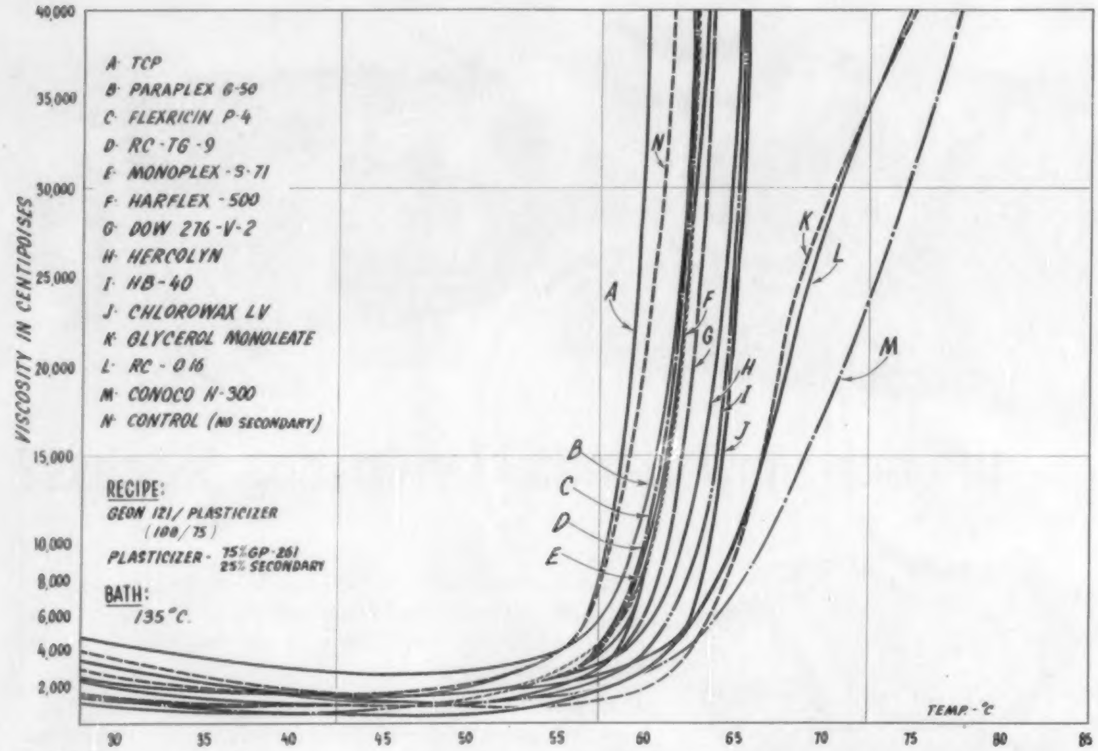


Fig. 7A: Effect of 13 different plasticizers (mostly primary) on viscosity

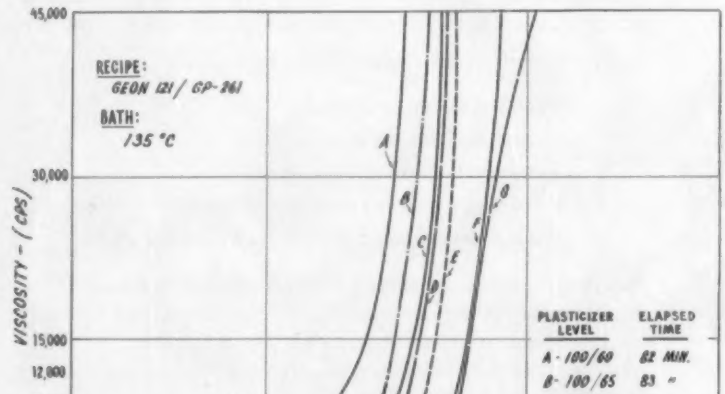


Fig. 8: Effect of plasticizer concentration

ingful in studying paste viscosities. (4)

Resin particle size affects plastisol viscosity and resin blends are often employed to achieve special flow properties. At a constant plasticizer level, the initial plastisol viscosity is proportional to the viscosity of the plasticizer. On aging, however, the solvent power[2] of the plasticizer is dominant and its action is magnified by an increase in temperature. This is illustrated by aging studies (5) as well as viscosity measurements of plastisols at different temperatures (Figs. 4 and 5, p. 160). Gelling agents may or may not increase viscosity, but most always result in an increase in yield value.

During the last 5 yr., there has been an increasing interest in the influence of temperature on plastisol viscosity because of the growth of such plastisol processes as rotocasting (6), hot dipping, spraying, and the production of expanded vinyl. Melting point bars have been used to determine the gelling and fusing temperatures of plastisols by extruding or casting a deposit of plastisol along the length of the bar, the gelling point being the point of non-fluidity and the fusion point being the point of clarity (in non-pigmented systems).

Another approach has been the employment of various gel timers (7). A spindle is immersed in a heated plastisol and the time required to develop a certain torque resistance corresponding to the gelled state is noted (8). While simple, this test

[2]For example, in going from butyl to decyl esters, the plasticizer is less solvating and lower plastisol viscosities are obtained.

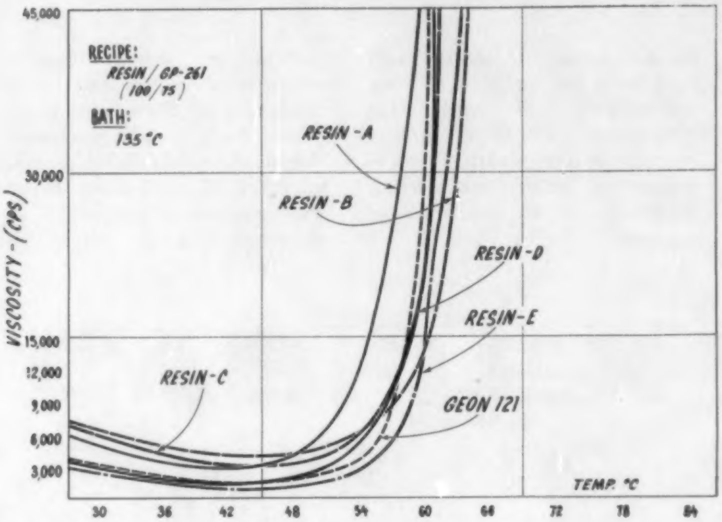


Fig. 9: Effect of various dispersion resins

provides only a one-point measurement. A third method involves tilting, thermal-gradient plate (9) down which a plastisol is allowed to flow for a definite time interval. The flow pattern obtained is a measure of the fluidity of the plastisol over the temperature range which is being investigated.

This procedure has the advantage of being fairly rapid but difficulties are encountered in finding conditions to compare plastisols of widely differing flow properties.

It is the purpose of this paper to describe a procedure for the study of plastisol viscosity-temperature characteristics and to

Table I: List of materials and suppliers

Resins	
Geon 121	B. F. Goodrich Chemical Co.
Geon 126	" " " "
Geon 202	" " " "
Plasticizers	
Acetyl tributyl citrate	Chas. Pfizer Co.
Benzoflex 9-88	Tennessee Products Co.
Chlorowax LV	Diamond Alkali Co.
Conoco H300	Continental Oil Co.
Flexol CC-55	Carbide and Carbon Co.
Flexol TOF	" " " "
Flexricin P4	Baker Castor Oil Co.
Glycerol monoleate (edible)	Glycol Products Co.
Goodrite GP-261 (DOP)	B. F. Goodrich Chemical Co.
Goodrite GP-266 (DDP)	" " " "
Goodrite GP-233 (DOA)	" " " "
Goodrite GP-236 (DDA)	" " " "
Harflex 500	Harwick Standard Co.
HB 40	Monsanto Chemical Co.
Hercolyn	Hercules Powder Co.
KP 220	Ohio-Apex Div., Food Machinery & Chemical Corp.
Kronitex AA (TCP)	" " " " " "
Monoplex DOS	Rohm & Haas Co.
Monoplex S71	" " "
O-16	Rubber Corp. of America
Paraplex G 50	Rohm & Haas Co.
Plastolein 9058 (DOZ)	Emery Industries, Inc.
Santicizer 141	Monsanto Chemical Co.
Santicizer 160	" " "
TG-9	Rubber Corp. of America
276-V-2	The Dow Chemical Co.
Fillers	
Supermultifex	Diamond Alkali Co.
No. 10 Whiting	Georgia Marble Co.
Stabilizers	
Advastab S 52	Advance Solvents & Chemical Co.
Advastab X2330	" " " "
Dyphos	National Lead Co.
12 V 5	Harshaw Chemical Co.
Additives	
Advawet X212	Advance Solvents & Chemical Co.
Aluminum stearate No. 72	Harshaw Chemical Co.
Lexinol AC	American Lecithin Co.
Neutral calcium petronate	L. Sonneborn Sons, Inc.
Santocel C	Monsanto Chemical Co.
Silicone 200 fluid	The Dow Chemical Co.
Sotex CW	Synthetic Chemicals Co.
10 V 442	Harshaw Chemical Co.

indicate the importance of these measurements to certain plastisol applications.

Test procedure and results

Materials: The resins, plasticizers, and other materials used in this investigation are listed in Table I, p. 163.

Viscosity determination: The method used in this work employed a Brookfield Viscometer in conjunction with a constant temperature oil bath as shown in Fig. 6, p. 160. Typical viscosity-temperature curves obtained in this fashion are illustrated in Fig. 7, p. 160. It is apparent that plasticizers differ widely in temperature and rate of solvation. Varying concentrations of the same plasticizer, illustrated in Fig. 8, p. 162, also play an important part in determining the resulting viscosity-temperature curves. As might be expected, different paste resins in the same plasticizer system give rise to different curves (Fig. 9, p. 163).

All the plastisols in this investigation were prepared in an N-50 Hobart mixer, de-aerated and aged for 1 day at 25° C. Mixing was performed at a resin/plasticizer ratio of 100/60 for the first 20 minutes. The remaining plasticizer was added and stirring continued for an additional 10 minutes.

There are several ways in which these curves can be altered to meet the conditions required for a specific application. One of the easiest is by utilizing mixtures of plasticizers. Blends with secondary plasticizers are shown in Fig 10, below, and

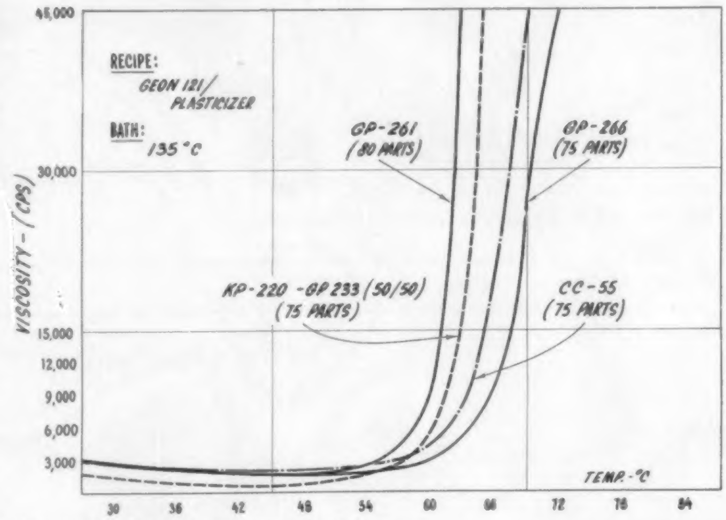


Fig. 10: Effect of secondary plasticizers

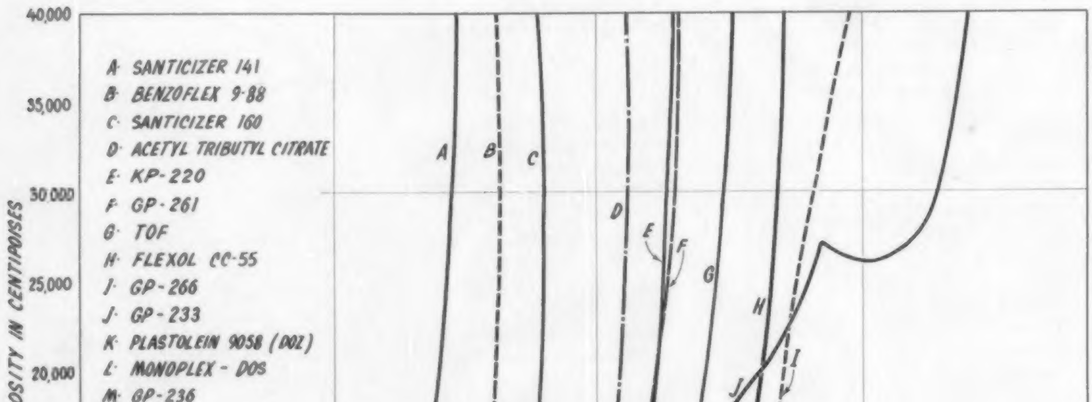


Fig. 10A: Effect of 13 secondary plasticizers on viscosity

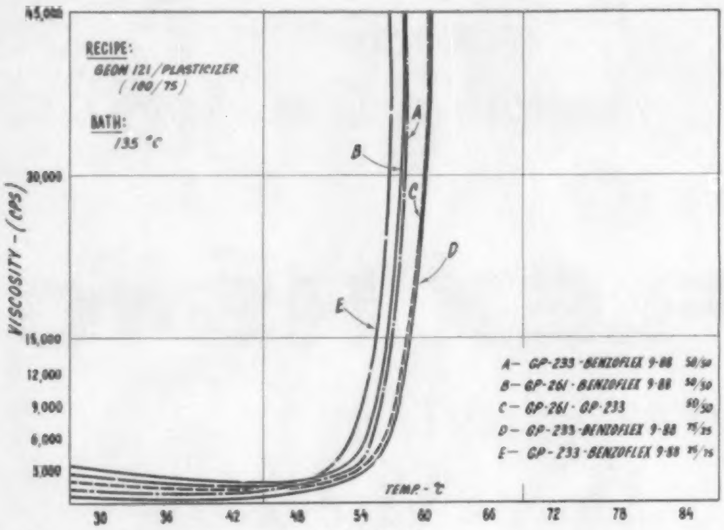


Fig. 11: Effect of primary plasticizer blends

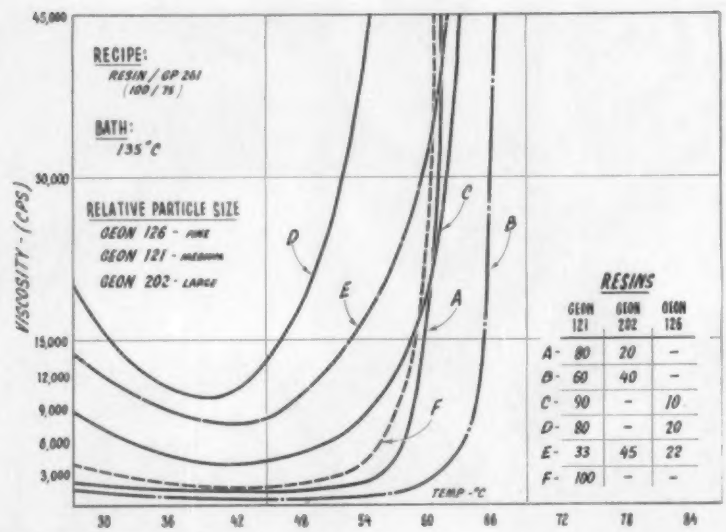


Fig. 12: Effect of six resin blends on plastisol viscosity

blends of primary plasticizers are shown in Fig. 11, left. The same principle can be applied to complex resin systems. It is interesting to note that the position of the curve can be moved in either direction by the substitution of appropriate amounts of various particle size resins which have different solvation properties (Fig. 12, left).

It will be noticed in all the graphs that the bath temperature used was 135° C. This temperature was chosen in order to provide sufficient driving force to produce a gelled state and yet maintain a magnification of viscosity differences. Also for the sake of magnification, 600 g. of sample were used. By using a large quantity of sample in a large diameter beaker, errors resulting from inaccurate centering of the spindle-thermometer unit are minimized. Wideness of range and convenience of operation led to the selection of a #4 spindle and a 12 r.p.m. speed. As a result of this procedure, the degree of reproducibility shown in Fig. 13, below, was obtained.

A limited examination of a single low oil absorption filler, four solid and liquid stabilizers, and certain viscosity reducing agents failed to indicate profound deviations from the control (Figs. 14, 15, 17, pp. 168-170). However, this was not the case with gelling agents, as demonstrated in Fig. 16, p. 168. Plastisols aged from 1 to 14 days at 25

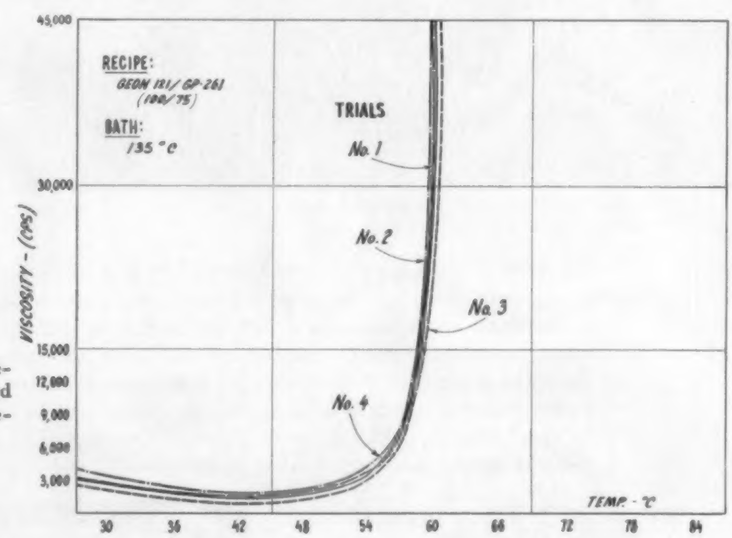


Fig. 13: Degree of reproducibility obtained with procedures described in text above

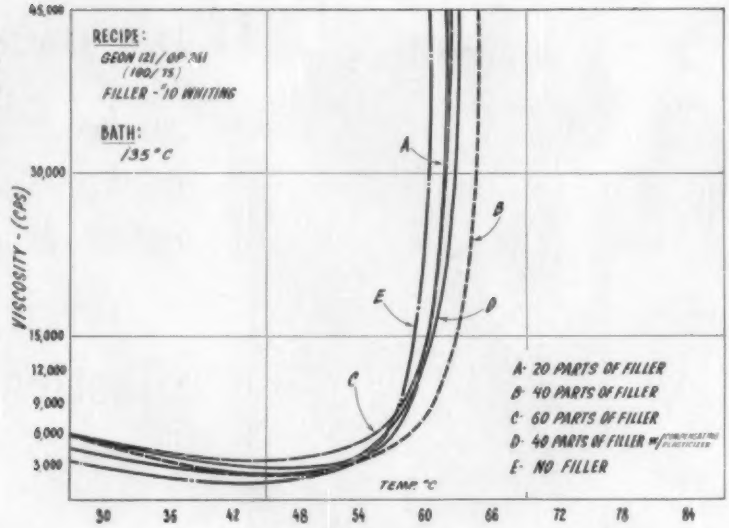
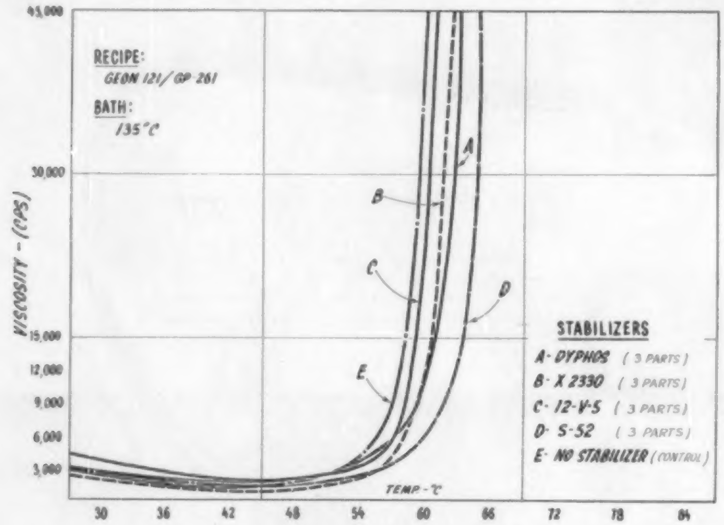


Fig. 14: Effect on viscosity of a single low oil absorption filler in various concentrations

Fig. 15: Effect of solid and liquid stabilizers on plastisol viscosity



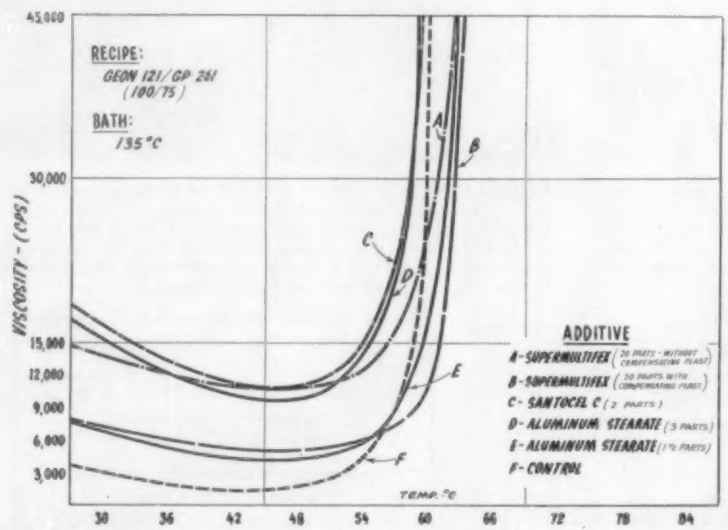


Fig. 16: Effect of gelling-agent-type additives

and 45° C. showed little change in the character of the curve other than the initial viscosity (Figs. 18 and 19, p. 170).

The features of the Brookfield test as described here are a high degree of magnification, completeness of curve from room temperature to region of gelation, adaptability to a wide range of plastisols, simplicity of equipment, and ease of operation. Although the length of time required to perform the test may be considered a disadvantage, modifications that will significantly reduce the time will be accompanied by a decrease in magnification.

Data on all primary and secondary plasticizers evaluated are shown in Figs. 7A, p. 162, and 10A, p. 164, respectively.

Applications

Rotational molding: The relationship of viscosity-temperature curves to rotational molding was explored to a limited degree. The principle of rotational molding (or rotocasting) is the simultaneous rotation of a sealed mold in the vertical and horizontal planes while heat is applied to gel and fuse the contained plastisol. A production machine of this type is shown in Fig. 20, p. 172. The results reported below were obtained on a single arm laboratory machine with a 5:4 ratio; that is, the molds rotate five revolutions in the horizontal plane to every four in the verti-

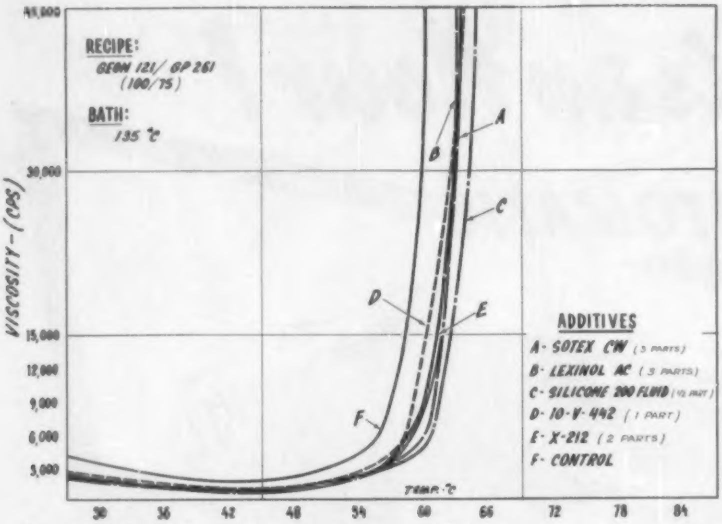


Fig. 17: Effect of viscosity-reducing-type additives

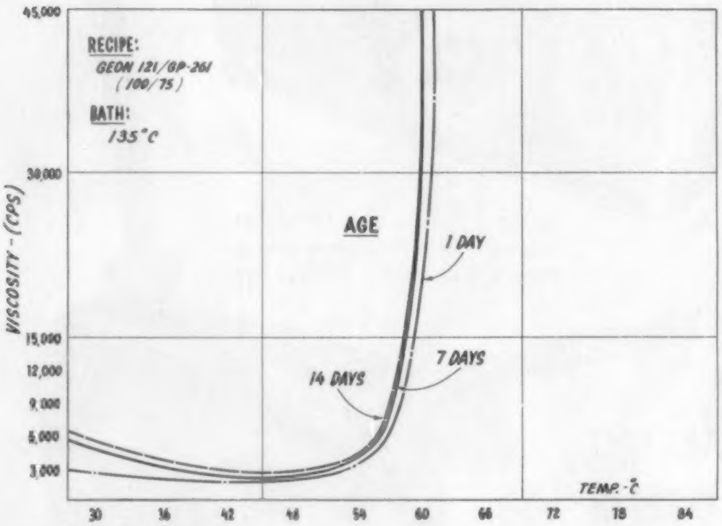


Fig. 18: Effect of aging (1 to 14 days) at 25° C.

cal (10) (Fig. 21, p. 172). Although correlation between production and laboratory machines may vary, useful trends are shown.

Ball molds (4-in. diameter) were chosen because this type of product is of considerable interest and also so that the results might have broader application. From the standpoint of rotocasting, the two most important problems in the production of balls are equal distribution of the plastisol and "lip" formation. Both are illustrated in Fig. 22, p. 172. Factors governing these problems are the viscosity-temperature relationship of the plastisol, speed of rotation, and the rate of mold heat up.

A series of balls were rotocast from a simple plastisol at different levels of GP-261 and under different operating conditions. The same series was repeated with GP-233. As evidenced in Table II, p. 174, good balls were produced at the highest temperature only at an 80-part level of GP-261. At the lower temperatures, good balls were produced at 60 and 70 parts of GP-261 and 60 and 70 parts of GP-233. From Fig. 23, p. 172, it is apparent that in the single case where good balls resulted at the highest temperature, the curve lies in a specific area. The curves of plastisols falling to either side of this area produced good balls only at lower temperatures.

Other plastisols with similar curves would be expected to give

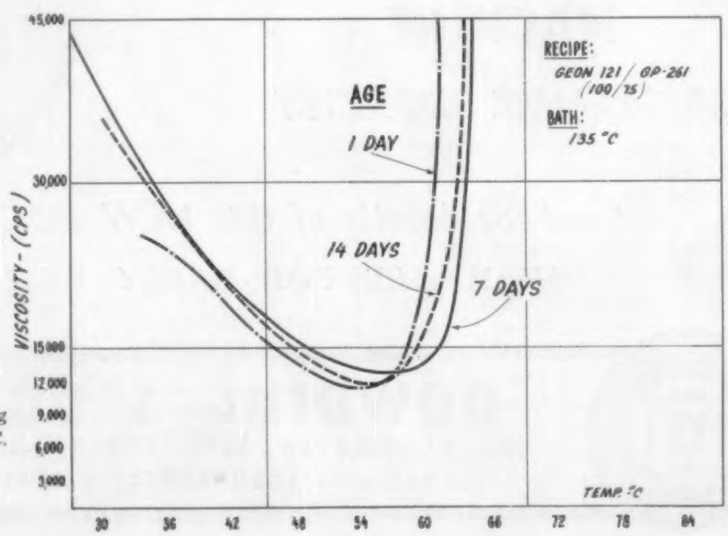


Fig. 19: Effect of aging (1 to 14 days) at 45° C.


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Fig. 20: Production rotocast machine. (Photo, Akron Presform Mold Co.)

Fig. 21: Laboratory rotocast machine. (Photo, Akron Presform Mold Co.)

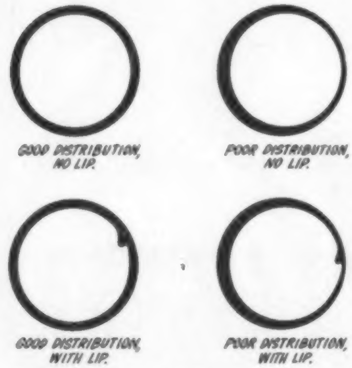

Fig. 22: Types of rotocast plastisol balls (schematic configurations): A — good distribution, no lip; B — poor distribution, no lip; C — good distribution, with lip; D — poor distribution, with lip

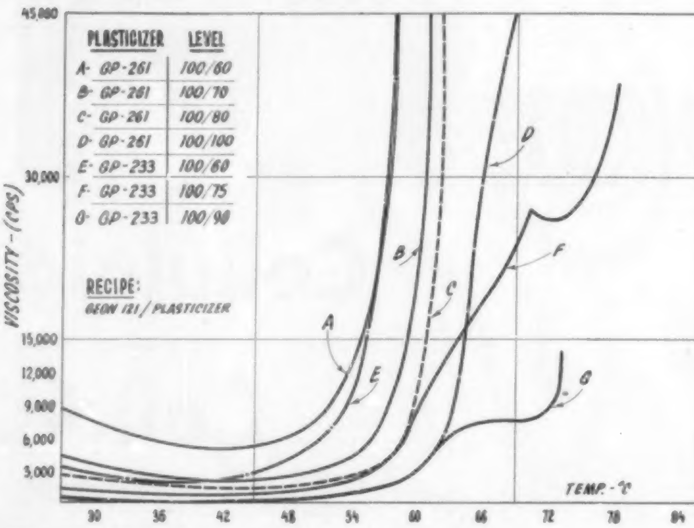

Fig. 23: Effect of plasticizer level

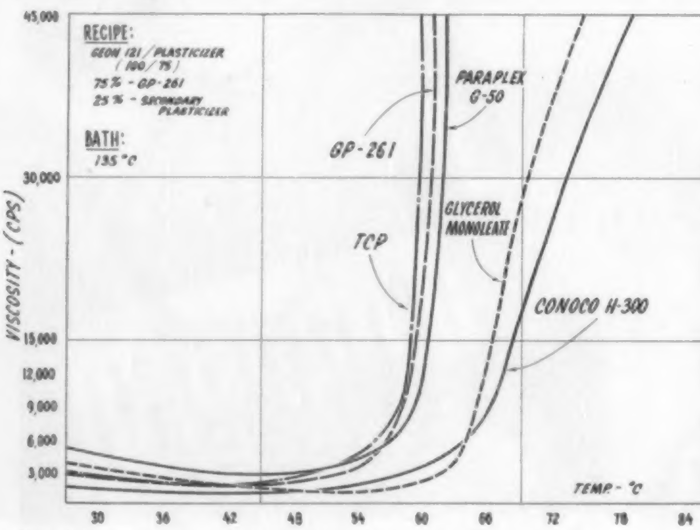

Fig. 24: Effect of selected plasticizers for rotocasting

comparable results. Three compounds were selected on the basis of the similarity of their curves to that of an 80 parts GP-261 plastisol (see Fig. 24, left). These compounds would therefore be expected to produce good balls at the highest temperatures. As predicted, this was generally the case as seen in Table III, p. 174. It is thus possible with the use of viscosity-temperature curves to compound plastisols that will permit higher processing temperatures and therefore increased economy through faster cycle times.

Dipping plastisols: Dip coating of preheated objects is influenced by the viscosity-temperature

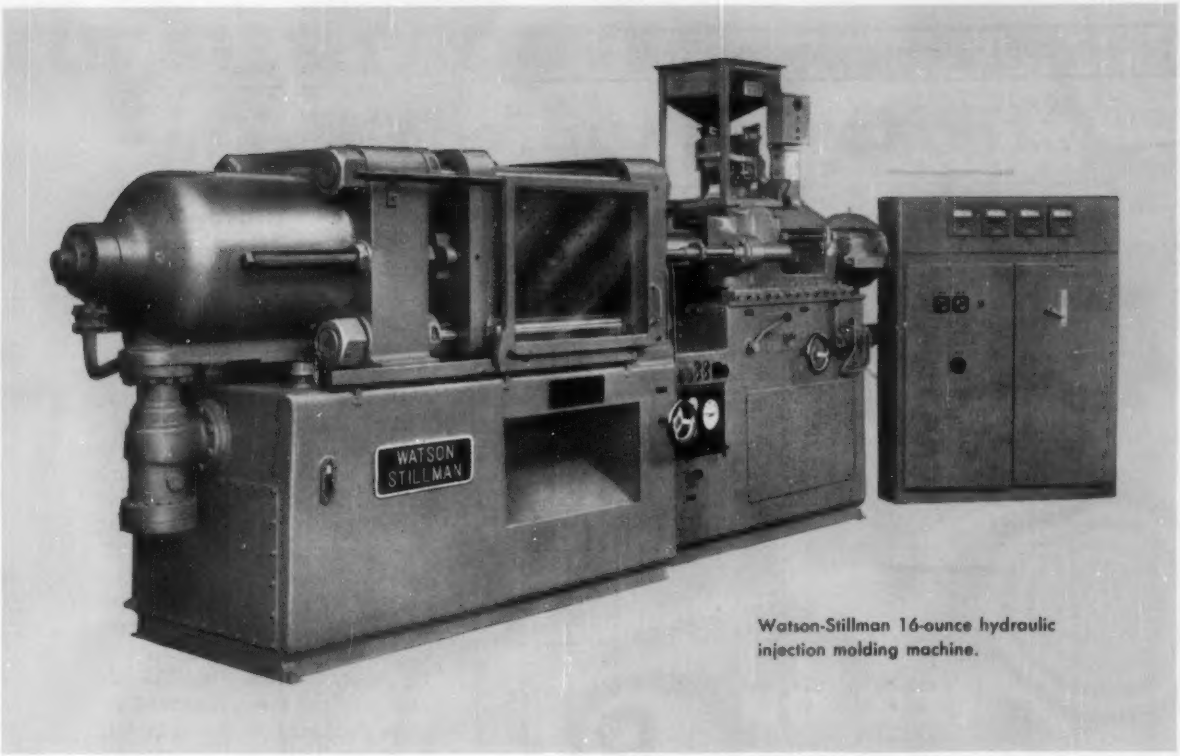

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Table II: Distribution and "lip" formation in rotocast balls

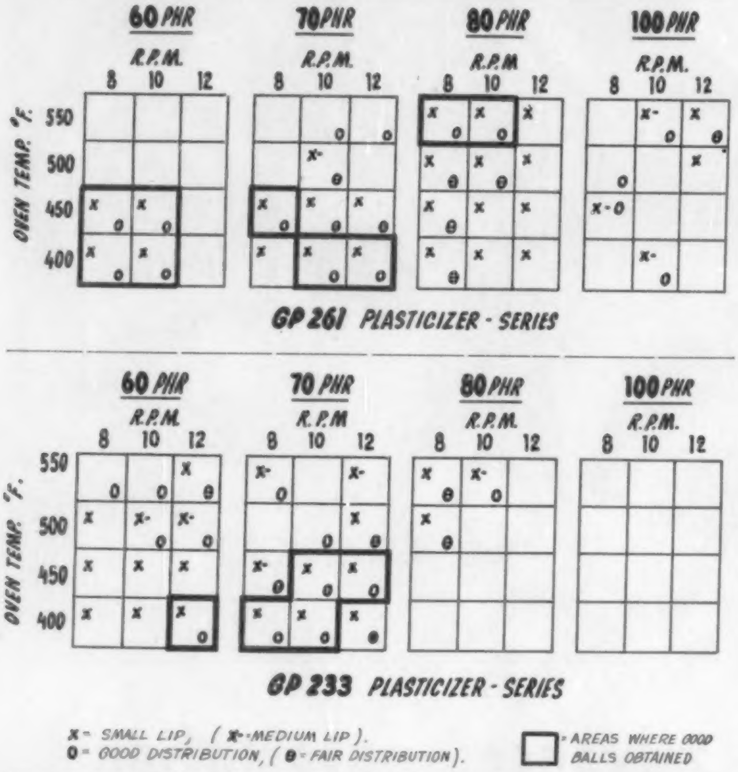
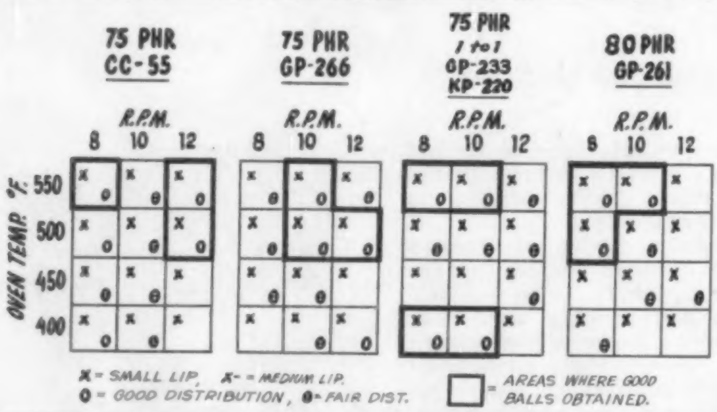


Table III: Distribution and "lip" formation in rotocast balls



characteristics of a plastisol. Important factors are the viscosity stability of the bath and the coating weights obtained. Both are governed to a large extent by the solvating properties of the plastisol.

A brief investigation of two plastisols possessing widely separated solvating properties was made. The plastisol having the faster gelling characteristics (GP-261) produced a heavier pickup weight at the lower mold temperatures, while the slower gelling plastisol (GP-233) gave comparable weights at the higher mold temperatures. These tests and results are shown in Table IV, p. 249. From this type of information, guidance can be obtained in choosing the proper plastisol and mold preheat temperatures for the desired coat thickness at maximum withdrawal rates.

Foamed plastisol: The production of open-cell sponge in thick sections is a process partially dependent upon plastisol viscosity-temperature characteristics. Successful low density sponge can best be produced when the blowing agent completely decomposes prior to gelation (11). When the final physical properties require a low plasticizer content, plasticizers of low solvating strength are indicated. At medium plasticizer levels, polymerics are suitable and at high levels, small quantities of highly solvating plasticizers can be incorporated. It has also been reported by Fuller (12) that certain additives are valuable with blowing agent BL-353 in retarding the solvating power of plasticizers. The effect of one of these, Neutral Calcium Petronate, is shown in Fig. 25, p. 249. Resin blends might also be suggested for this purpose.

Hot spray plastisols: Hot spraying depends on the viscosity drop of coating materials at elevated temperatures. Its application to plastisols takes advantage of their initial decrease in viscosity with temperature rise as shown in Fig. 5. Formulations previously considered too high in viscosity may now be considered for hot spraying. The viscosity-temperature curve provides a means of determining the minimum viscosity point and should be helpful in this type of formulating.

In summation, the viscosity-temperature characteristics of plastisols are inherent to many applications. Curves depicting these characteristics provide a means of analysis and assist in the proper selection of ingredients and operating conditions.

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(*To page* 249)

Durability of modified polystyrenes

By L. Gilman, Kenneth T. Carolan†, and Milton Resnick‡*

Some unmodified polystyrene compositions are only moderately affected by either 3-yr. exposure at 160° F. or 3-yr. exposure outdoors in the latitude of northern New Jersey, but other compositions are very greatly affected. The compositions that were most seriously affected by one of these exposures were also most seriously affected by the other and have shown greatly reduced impact strength at the end of 6 mo. at 160° F.

Very considerable differences both in initial properties and in durabilities were observed among materials consisting of polystyrene modified with GR-S rubber, but a styrene-acrylonitrile copolymer modified with butadiene-acrylonitrile rubber had greater toughness and greater durability than any of the polystyrene-GR-S compositions tested. Manufacturers can produce these materials with a wide range of toughness and simultaneously with a much lesser range in flexural strengths. The ranges in toughness are much greater after exposure than before, but the ranges in strength and stiffness are little affected by exposure.

Some years ago, materials manufacturers introduced injection molding compounds consisting of polystyrene modified by the incorporation of various rubber-like polymers. These molding materials had immediately apparent advantages over unmodified polystyrene in mechanical toughness and had a combination of other properties that made the materials distinctly attractive for numerous applications. However, it is well known that many rubber polymers are embrittled by prolonged exposure to temperatures above about 120° F., this effect becoming increasingly apparent above 158° F. In addition, many rubber polymers are embrittled by exposure to outdoor environments.

Accordingly, it was important to ascertain to what extent these modified polystyrenes would retain their toughness during storage at somewhat elevated temperatures and during exposure outdoors.

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Test procedure and data

Five of these modified styrene materials from five different manufacturers were selected for test. Material No. 1 was described as a mechanical mixture of styrene-acrylonitrile copolymer with a butadiene-acrylonitrile rubber. Materials Nos. 2 to 5 were described by their manufacturers as mechanical mixtures of polystyrene with GR-S rubber. The materials were furnished in each manufacturer's standard color which he deemed nearest to olive drab. All specimens were molded in a 4-oz. Watson-Stillman injection machine at 5° C. above the minimum molding temperature. The minimum molding temperature was taken as the lowest temperature that would make possible ten successive full shots in the mold.

Specimen dimensions, conditioning, and test procedures complied with the requirements of methods 1031 and 1071 of Federal Specification L-P-406b, "General Specification for Test Methods for Organic Plastics."

During storage at 160° F., the specimens were stacked so that air could circulate freely around each piece. For outdoor exposure, the specimens were mounted in aluminum frames so that all except the ends were fully exposed. The frames were mounted on racks at 45° to the horizontal and facing true south. Test location was the Picatinny Arsenal, Dover, N.J.

The test data are given in Table I, p. 178. Each value listed is the average of five determinations for flexural properties and ten determinations for impact strength.

Evaluation factors

Choice of properties for measurement: Impact strength was selected as one of the properties to be measured in this investigation because the principal purpose of modifying polystyrene with rubber-type polymers is to increase toughness. Flexural properties were chosen as a group for inclusion, because the flexural test is relatively economical to perform, has good reproducibility, and will clearly distinguish between stable properties on the one hand and properties that are changing during exposure on the other. Flexural deflection (deflection at break), ultimate flexural strength, and flexural modulus were calculated. Flexural deflection is related to ductility and toughness, although it is probably less of a direct measure of toughness than are some other properties. Flexural strength is a measure of strength as distinct from tough-

Table I: Properties of modified polystyrenes after exposure

Time of exposure	Exposed at 160° F. Impact strength	Exposed at 160° F. Flexural deflection	Exposed at 160° F. Flexural strength	Exposed at 160° F. Flexural modulus	Exposed outdoors Impact strength	Exposed outdoors Flexural deflection	Exposed outdoors Flexural strength	Exposed outdoors Flexural modulus
mo.	*ft.-lb./in. of notch*	*in.*	*p.s.i.*	*10³ p.s.i.*	*ft.-lb./in. of notch*	*in.*	*p.s.i.*	*10³ p.s.i.*
				MATERIAL NO. 1				
0	6.58	0.792	5040	185	6.58	0.792	5040	185
6	6.49	0.718	6010	189	6.82	0.681	5750	191
12	6.52	0.725	7300	227	7.03	0.711	6780	231
24	5.81	0.850	7310	228	6.74	0.69	6460	228
36	5.25	0.650	7210	220	6.85	0.700	6770	229
				MATERIAL NO. 2				
0	3.56	0.629	6750	214	3.56	0.629	6750	214
6	3.24	0.568	7130	251	2.78	0.561	7410	220
12	2.99	0.559	8220	281	3.50	0.361	6420	278
24	2.58	0.061	8210	269	2.60	0.280	5440	252
36	2.36	0.780	8220	263	2.40	0.300	5490	268
				MATERIAL NO. 3				
0	1.25	0.813	7870	323	1.25	0.813	7870	323
6	1.07	0.818	8470	348	1.03	0.838	8160	332
12	1.05	0.810	9920	362	1.07	0.691	9380	366
24	1.03	0.920	9290	369	1.04	0.550	9230	356
36	0.96	0.920	9380	351	0.94	0.570	9360	367
				MATERIAL NO. 4				
0	3.32	0.690	8580	342	3.32	0.690	8580	342
6	0.64	0.293	10400	408	1.58	0.552	8940	361
12	0.47	0.274	11600	471	1.36	0.375	10300	413
24	0.38	0.280	12500	475	0.95	0.260	9100	407
36	0.32	0.262	11700	490	0.93	0.246	8810	419
				MATERIAL NO. 5				
0	1.82	0.648	9380	300	1.82	0.648	9380	300
6	0.54	0.288	9150	364	1.09	0.528	9230	327
12	0.34	0.265	10800	468	1.01	0.358	9190	376
24	0.25	0.270	12000	475	0.98	0.180	6170	377
36	0.25	0.260	11800	490	0.83	0.260	7760	371

ness, and modulus is a measure of stiffness.

Considerations in assessing deterioration: When several properties of a material change during exposure, special problems arise in assessing the effects of the exposure. These problems arise because normally some properties are adversely affected while, at the same time, other properties may be beneficially affected. Accordingly, simply saying that the material has deteriorated may not be wholly true. We can take data in this report as illustrative.

Table II: Effect of outdoor exposure on material No. 2

	Original values	*Values after 3-yr. exposure*
Flexural strength, p.s.i.	6800	5500
Flexural modulus, p.s.i.	214,000	268,000

As shown in Table II, below, the flexural strength of material No. 2 has been decreased, but modulus has been increased by this exposure. A designer considering the use of this material must generally design on the basis of 5500 p.s.i. for flexural strength and 214,000 p.s.i. modulus, because most end items have minimum requirements in both strength and rigidity, and these requirements must be met at all times during the life of the part. Accordingly, speaking in general, we have to say the exposure has had a deteriorating effect on the material because we have to design on the basis of poorer properties than the material originally possessed, even though the modulus has been increased by exposure. However, there are applications in which stiffness will be of greater importance than strength. For such applications we would say that the exposure has had no deteriorating effect, because we can design on the basis of the original properties with no anticipation of loss in significant mechanical characteristics.

Accordingly, whether or not a material is deteriorated or adversely affected by given exposure conditions depends upon which property or which group of properties are required for the particular application in question.

The changes in the properties of rubber-modified polystyrenes


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Table III: Flexural strength after 3 years at 160° F.

Material	Percent of original value	Actual value after 3 yr.
		p.s.i.
No. 1	143	7,210
No. 4	136	11,700
No. 5	126	11,800
No. 2	121	8,220
No. 3	119	9,380

during exposure to elevated temperature or to outdoor conditions are of this sort. In general, impact strength and flexural deflection decreased, while flexural strength and flexural modulus increased. This would lead us to expect that the materials would resist loads applied at a low rate better after exposure than before. We would expect the materials to resist shock loads less readily after exposure than before. In practice, for most applications, this will mean that the materials are deteriorated by exposure and are less satisfactory after exposure, but, at the same time, there will be instances in which performance will be improved by this same exposure. No single, simple statement tells the whole truth.

Another problem arises in the choosing of an apparent criterion for comparing durabilities of various materials. Should a material be judged on the percent change in properties or on the basis of its actual final strength values? Table III, above, shows that these two bases of evaluation lead to greatly different conclusions.

There appears to be no simple answer by which we can say that one material resists exposure better than another, unless we simultaneously consider a particular application. For most purposes, the actual final values of the relevant mechanical properties will be of more significance than the relationships of the final values to the original. On the other hand, when permanence of properties with time rather than maximum strength is desired, or in studies involving the effectiveness of stabilizers, a small percent change will probably be more desirable than a particularly high final value.

These considerations call attention to the fact that a report such as this one on the subject of durability of various materials cannot be summarized in simple, widely inclusive conclusions; the properties that will be of significance in connection with each proposed application of these materials must be ascertained, and all of the relevant data concerning these properties must be examined. A best choice of material can then be made for a given proposed end item under specified conditions of exposure. Accordingly, a report of this sort is a source of much relevant information, but is not normally usable as a source of ready made answers.

Resistance to 3-yr. exposure

Table I gives values of each of the four properties measured after 6-, 12-, 24-, and 36-mo. exposure to each condition. Final property values after exposure at 160° F. are given in Table IV, below.

Since the principal purpose of modifying polystyrene with rubber-type polymers is to increase its toughness and its resistance to shock loads, the materials have first been listed in the order of their impact strength at the end of the exposure time. On the basis of flexural deflection determinations, the materials would be rated in a somewhat similar but not exactly the same order. This tends to confirm the general order of toughness of polystyrene materials as found by the Izod impact test.

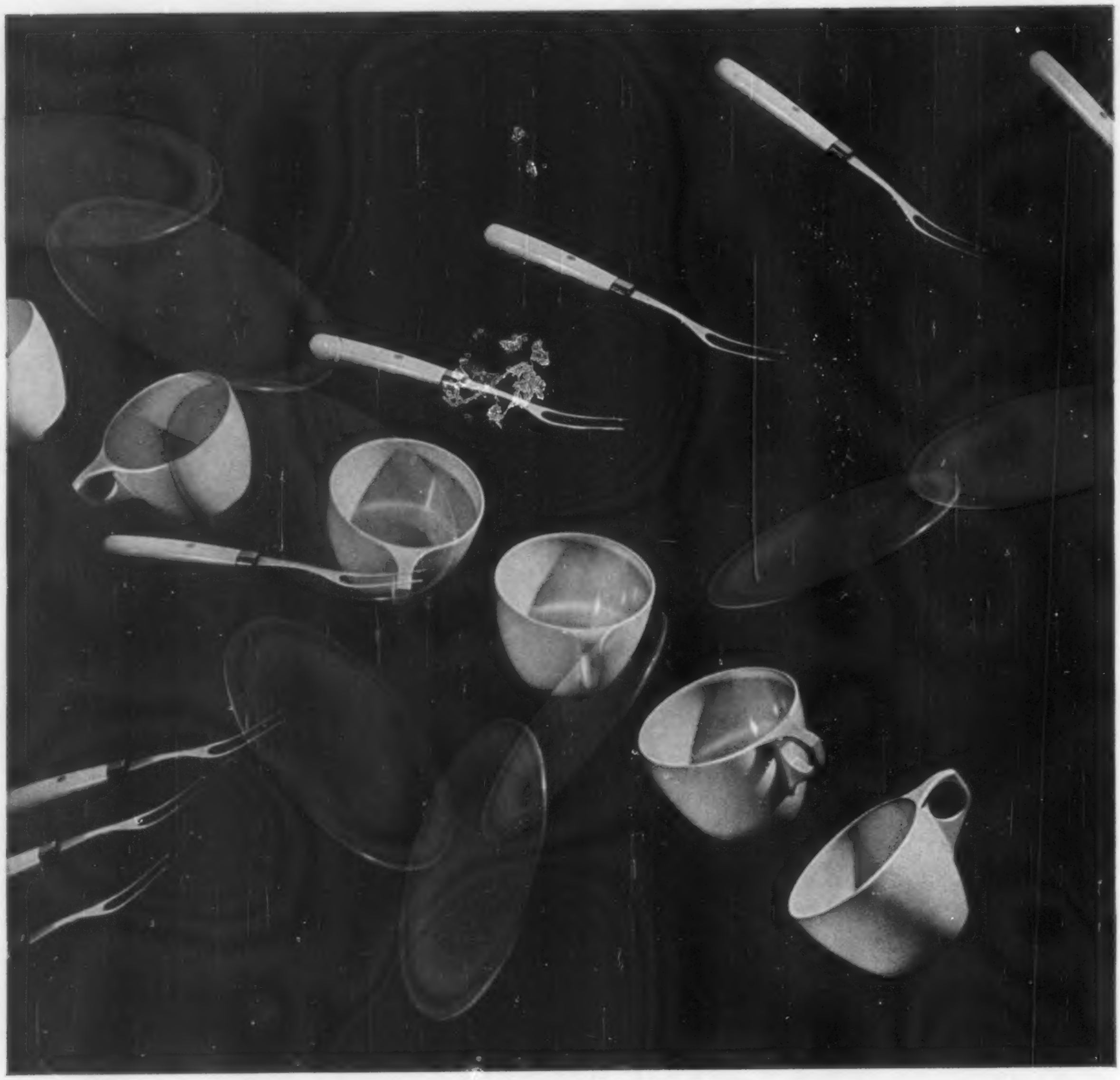
On the other hand, the order of flexural strength is exactly opposite to that of impact strength, and the order of flexural modulus is exactly the same as that of flexural strength. All of this is entirely consistent, since increased impact strength in a plasticized linear polymer is normally accompanied by decreased modulus and decreased flexural or tensile strength.

Table V, p. 185, shows the final property values of the materials after 3-yr. exposure outdoors. The materials have final impact strengths in the same order as they had after 3-yr. exposure at 160° F. Flexural deflection again showed a marked tendency toward the same order. Flexural strengths and flexural moduli were not in exactly the opposite order of impact strengths, but each showed a marked tendency in that direction. Thus, again, highest toughness and ductility tended to be accompanied by lowest strength and modulus.

Comparing these five materials (*To page* 185)

Table IV: Property values of modified polystyrenes after 3 yr. at 160° F.
(arranged in order of decreasing values)

Material no.	Impact strength	Material no.	Flexural deflection	Material no.	Flexural strength	Material no.	Flexural modulus
	ft.-lb./in. of notch		in.		p.s.i.		10^3 p.s.i.
1	5.25	3	0.920	5	11,800	5	490
2	2.36	2	0.780	4	11,700	4	490
3	0.96	1	0.650	3	9,380	3	351
4	0.32	4	0.262	2	8,220	2	263
5	0.25	5	0.260	1	7,210	1	220



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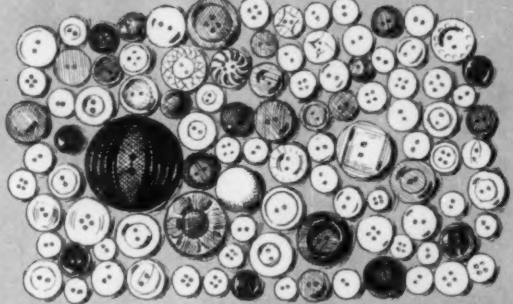
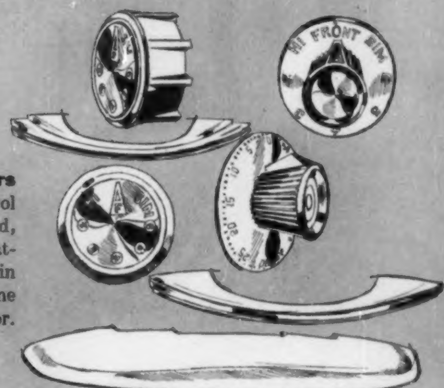


The ruggedness and durability of these materials are vividly demonstrated in urea and melamine buttons. They are subjected to the punishment of continual torture tests . . . repeated washings in strong, soapy water, contact with hot irons and the abuse of everyday wear—yet they look sparkling new after years of service.



Stove manufacturers use PLASKON Urea for control knobs because it has a very hard, glossy surface and good heat-resistance. Urea is widely used in electrical appliances for the home because of its ability as an insulator.

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among themselves, it will be seen from the data in Table VI, below, that there is a considerable spread in each property from material to material. This spread is greatest in impact strength and flexural deflection—the toughness properties—and is much less in flexural strength and in modulus—the strength and stiffness properties. The spread in toughness properties is greatly increased by the 3-yr. exposure, but the spread in strength and stiffness is essentially unaffected. Initially, as molded, the toughest material had an impact strength that was 5.3 times that of the least tough material. The most ductile material had a flexural deflection 1.3 times that of the least ductile material.

Table V: Property values of modified polystyrenes after 3-yr. outdoor exposure
(arranged in order of decreasing values)

Material no.	*Impact strength*	*Material no.*	*Flexural deflection*	*Material no.*	*Flexural strength*	*Material no.*	*Flexural modulus*
	ft.-lb./in. of notch		*in.*		*p.s.i.*		*10^3 p.s.i.*
1	6.85	1	0.700	3	9360	4	419
2	2.40	3	0.560	4	8810	5	371
3	0.94	2	0.300	5	7760	3	367
4	0.93	5	0.260	1	6770	2	268
5	0.83	4	0.264	2	5490	1	229

Table VI: Maximum differences in properties among the five materials

Property	*Factor by which material with highest value exceeded that of material with lowest value* Initially	After 3 years	*Increase in factor during exposure*
			%
Impact strength	5.3	21	300
Flexural deflection	1.3	3.5	170
Flexural strength	1.9	1.7	slight decrease
Flexural modulus	1.8	2.2	20

After exposure for 3 yr., the impact strength of the toughest material was then 21 times as great as that of the least tough, and the flexural deflection of the most ductile was 3.5 times that of the least ductile. The spread in impact strength had increased by a factor of 4 during exposure, and the spread in flexural deflection had increased by a factor of 2.7.

On the other hand, the strongest material originally was 1.9 times as strong as the weakest and the stiffest was 1.8 times as stiff as the most flexible. The corresponding ratios after exposure were 1.7 and 2.2. Accordingly, the spreads in strength and modulus had changed very little during exposure.

These figures seem to show that manufacturers can introduce a very wide range of toughness in the original materials with a much lesser range in strength and stiffness. Even more important, it appears that the differences in toughness after exposure are far greater than are these differences originally.

Data were obtained for all properties at twenty time intervals from 0 to 36 mo., although data for only 0, 6, 12, 24, and 36 mo. are given in this article. The value of the additional data does not seem to be sufficient to warrant their publication. Although there are many short-term trends observable in the complete data, each final value seems to be reasonable relative to the over-all trend during the latter part of the exposure period. Accordingly, it appears to be safe to accept these final values as being reasonably representative for the end of a 36-mo. exposure.

Considering situations in which either of these exposures is anticipated and consisting of applications in which a shock-resistant thermoplastic is required, it would appear that Material No. 1 should be considered, because this material retained a minimum impact strength of 5.25 ft.-lb./in. of notch and a very considerable flexural deflection in spite of losses of as much as 20% during exposure. However, it must be remembered that this is a material of relatively moderate strength (flexural strength 5000 p.s.i.) and of relatively low stiffness (flexural modulus 185,000 p.s.i.).

If a somewhat lesser toughness can be tolerated, Materials Nos. 2 and 3 retained minimum impact strengths of 2.36 and 0.94 after 3-yr. exposure and also retained at least moderate flexural deflections. The strength of No. 2 is only a little greater than that of No. 1, but the stiffness of either is definitely higher. Materials Nos. 4 and 5 lost so much toughness during exposure that they should not be used for applications in which toughness is required and in which either of these 3-yr. exposure conditions would be encountered.

However, materials that would not be satisfactory after 3-yr. exposure may be satisfactory for shorter periods of time. Accordingly, in connection with applications to which exposure for lesser times is involved or in which one but not the other of these exposures is anticipated, decision would have to be based upon a careful consideration of which properties are essential and upon the value expected for those properties after the time interval involved. The detailed data in the accompanying tables will provide a basis for decisions in many instances.

Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Historical survey of plastics. J. H. Collins. Plastics Inst. Trans. and J. *24,* 100-12 (Apr. 1956). A brief survey that describes the beginnings of each of the well known types of plastics is presented.

Raw materials in the plastics industry 1945-1965. T. C. Corbett. Plastics Inst. Trans. and J. *24,* 113-24 (Apr. 1956). The production of plastics materials and related raw materials in the United Kingdom is discussed.

Materials

Volatility of vinyl plasticizers. W. J. Frissell. Ind. Eng. Chem. *48,* 1096-99 (June 1956). The volatility of vinyl plasticizers is based on results from several different tests. Vapor pressure data are shown and compared with results from the activated carbon volatility test run on thin film. A test for measuring volatile loss during milling of a plasticized vinyl compound is described. This test is shown to correlate well with vapor pressure data and to a lesser degree with activated carbon test data. The milling volatility test results are used to calculate losses during calendering of thin film. Weight losses are reported for samples of 4-mil film that were suspended in a laboratory for a period of 2½ years. These results indicate no significant loss due to volatility for the commonly used ester-type plasticizers.

Compounding acrylate polymers for resistance to a diester lubricant. W. J. Mueller and R. A. Clark. Ind. Eng. Chem. *48,* 982-91 (June 1956). Studies were made to develop an acrylate rubber composition that would resist degradation and swelling when aged 500 hr. at 350° F. in a synthetic diester lubricant, Turbo oil-15. The acrylate rubbers investigated included Hycar 4021 and Acrylon EA-5. Although none of the compositions developed completely met the minimum target requirements of the Air Force, four made with Hycar 4021 were found to be most promising. These met the target requirements, except for having a swell that was 5 to 10% higher than the 30% maximum desired. Among several vulcanizing systems investigated, the best rubber aging properties were obtained with a combination of triethylenetetramine, sulfur, and tetramethylthiuram disulfide. Long cures, and in some instances tempering, were beneficial to the aging characteristics of the rubber.

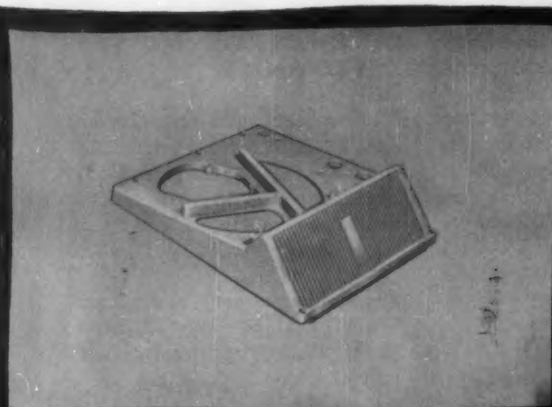
*Reg. U. S. Pat. Off.

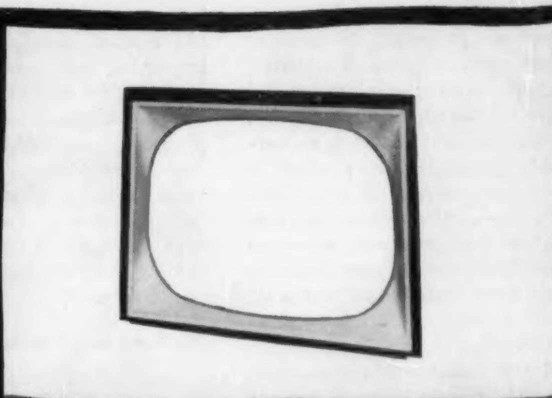
Some copolymers of vinyl alcohol-acrylonitrile. S. Sonnerskog. Acta Chem. Scandinavica *9,* 263-67 (1955). Copolymers of vinyl alcohol and acrylonitrile were prepared by selective hydrolysis of emulsions of the corresponding vinyl acetate-acrylonitrile compounds with ammonia at slightly elevated temperature. The presence of acrylonitrile groups in the polyvinyl alcohol chains does not lead to increased molar cohesions and a corresponding increase in filogenic properties. However, the polymers are compatible with pure polyacrylonitrile in solution (solvent: dimethyl formamide) and synthetic fibers can be prepared from such binary systems. Compared with pure polyacrylonitrile fibers the most obvious changes are the enhanced affinity for dispersed (acetate) and acid dyestuffs. The observed decrease in tenacity and increase in elongation at break is expected.

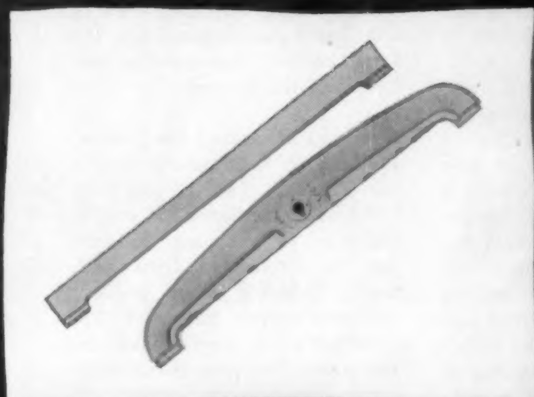
Universal glass finish for reinforced plastics. E. L. Strauss. Materials & Methods *43,* 106-07 (Jan. 1956). Previous published data have shown that epoxy and phenolic laminates utilizing NOL 24 finish have flexural strengths, dry and wet, about 15 to 20% higher than comparable laminates made with Volan A. Now data are available which indicate that polyester-glass laminates made of fabric treated with NOL 24 are equal to or slightly better than comparable Volan A laminates for nearly all loading conditions evaluated. NOL 24 is a halosilane produced by reacting equimolar amounts of allyltrichlorosilane and resorcinol; it improves the wetting of the glass fibers by the resin by providing a chemical linkage between the two.

Asbestos-reinforced low-pressure laminates. J. B. Campbell. Materials & Methods *43,* 103-07 (Feb. 1956). Asbestos-reinforced low-pressure laminates, used for almost a decade in England, now look promising for use in this country because of the availability of an improved supply of the right kind of asbestos. Although asbestos laminates have a somewhat lower room temperature strength than glass laminates, they have better strength retention at elevated temperatures. Other advantages include high flame resistance, acid resistance, dimensional stability, and ability to bond readily to many materials. Asbestos costs much less than glass, and it can be combined with glass to produce laminates with improved properties. The data now available on the properties of low-pressure asbestos laminates are summarized in charts and graphs and are discussed in some detail.

Urethane rubber from a polyether glycol. Properties of raw polymer and vulcanizates. F. B. Hill, C. A. Young, J. A. Nelson, and R. G. Arnold. Ind. Eng. Chem. *48,* 927-29 (May 1956). The properties of the raw polymer and of the vulcanizates of a urethane







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Using the epoxy resins. C. V. Wittenwyler. Chem. Eng. Prog. *52,* 53F-56F (Feb. 1956). The history and chemistry of the epoxy resins are reviewed, and the properties and applications of these resins are comprehensively discussed. Epoxy resins are characterized by good cures at low temperatures, low shrinkage during cure, excellent adhesion, broad spectrum chemical resistance, good electrical properties, good flexibility, high solvent resistance, and wide control over product properties. Epoxy coatings are used for household paints and varnishes, food-can linings, industrial-maintenance paints, corrosion-resistant primers, chemically-resistant equipment enamels, and wire enamels. Epoxy laminates are used to make printed circuits, radomes, storage tanks, and high-strength corrosion-resistant pipes. Epoxy castings are used to pot or encapsulate electronic circuits for protection from moisture, shock and vibration; and in tooling, to make dies used to form sheet metal. The wide use of epoxy adhesives in aircraft structures exemplifies their high strength and dependability.

Chlorinated phenol ethers. O. Pesta and F. Sinwell. Kunststoffe *46,* 155-59 (Apr. 1956). Some of the ethers of chlorinated phenols, especially tetrachlorodibutoxibenzene, were found to be suitable extenders as well as plasticizers for polyvinyl chloride electrical insulating materials by improving their electrical properties. They are also suited for the production of viscosity-stable plastisols, especially those with low plasticizer content which yield harder products after gelation. The ethers are also stable plasticizers for chemical-resistant coatings of cyclized or chlorinated rubbers.

Molding and fabricating

Barrel finishing plastics moldings. E. C. Emslie. Brit. Plastics *29,* 22-25 (Jan. 1956). Barrels for finishing plastics moldings may be made of metal with or without lining, of wood with wire mesh panels, or entirely of wood. In every case, an octagonal barrel is preferred to maintain a flow or slide in the barrel without any fall. Wire mesh barrels can be used to remove flash from the outer flash lines of moldings and have the advantage of causing little damage to the external surfaces. In many cases, the molding needs no further finishing. A metal, water-tight barrel, in conjunction with chips or balls, is used for deflashing by self-barreling with water and detergent, and for deflashing internal flash lines without the use of water. In using an abrasive medium for removing internal flash lines, care must be taken not to damage the surfaces. Barrels used for final polishing are made of wood in such a way as to admit as little air as possible and free from internal obstruction. To obtain best results, heat must be generated in the barrel. Polishing media include wax balls, plastics clippings, and leather cuttings.

Modern views on extrusion machinery. E. G. Fisher. Plastics Inst. Trans. and J. *24,* 143-52 (Apr. 1956). Various types of screws for extrusion are illustrated.

Applications

How new internal coatings are proving their worth. W. T. Theis. Oil and Gas J. *54,* 151-53 (Feb. 13, 1956). Epoxy resin coatings are used to coat the inside of metal pipelines to protect them from corrosion and deposition. The method of application, properties, and service data on coated pipelines are reported.

How to make and repair epoxy dies. N. E. Talbert. Modern Machine Shop *28,* 128-32 (Jan. 1956). Detailed instructions for making and repairing dies made of epoxy plastics are given.

Drums don a poly coat. Chem. Week *78,* 57-58 (May 12, 1956). Metal drums are coated with polyethylene by putting some polyethylene powder in them and tumbling while hot. They are then baked and quenched quickly. The rapid cooling improves the adhesion of the coating.

New plastic coating for printing finishing. H. E. Crawford, Jr. Paper Trade J. *140,* 24 (Mar. 26, 1956). A superior new coating material for printing finishing can be formulated from half-second butyrate (a low viscosity cellulose acetate butyrate). The relatively low viscosity of the half-second butyrate permits lacquers of high solids content with inexpensive solvent systems. It has good initial "whiteness" plus excellent light fastness without the aid of heat or color stabilizers. When properly formulated and applied, it possesses high gloss, low flammability, good abrasion resistance, and high block resistance. High drying temperatures are not needed. It is neutral toward ink pigments and dryers. Its cost is competitive. Incorporation of isopropyl titanate promotes adhesion to refractory inks with minimum application of force drying, and enhances heat and solvent resistance.

Properties

Structure of crystalline 1,2-polybutadiene and other "syndyotactic polymers." G. Natta and P. Corradini. J. Polymer Sci. *20,* 251-66 (May 1956). With the aid of anionic polymerization catalysts, 1,2-polybutadiene of high molecular weight was synthesized. It is a crystalline material with a melting point above 150° C. Electron and X-ray diffraction studies with oriented films permitted determination of the elementary cell, the space group, and the co-

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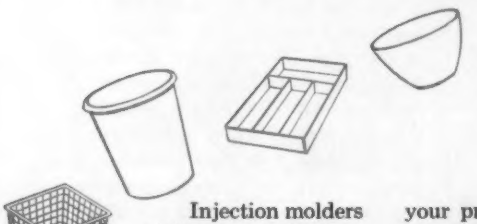

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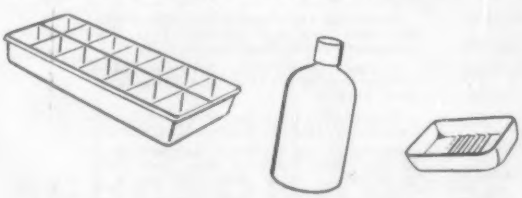

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ordinates of the individual carbon atoms in the cell. The chains deviate slightly from the conventional planar zig-zag structure; the vinyl group substituents are arranged in the 1-3 sequence with alternating *D* and *L* configurations. It is proposed to call this type of spatial arrangement in head-to-tail vinyl polymers a syndyotactic arrangement. Also polyvinyl chloride, obtained with free radical catalysts, contains small ordered regions, with a structure similar to syndyotactic 1,2-polybutadiene.

Dilaminar elastomeric films. M. G. Defries, L. Schneider, P. Fram, and F. Leonard. J. Polymer Sci. *20*, 267-86 (May 1956). Many applications of rubber-like materials require a combination of bulk and surface properties. These may not be attained with a specific elastomeric composition regardless of vulcanization, reinforcement, or other modification by compounding, but may be achieved by combining two materials in a laminated structure. A technique for casting hollow laminated elastomeric structures from aqueous dispersions in molds of plaster of Paris is described. An elastomeric composition which has the properties required of the surface is deposited first, and a second composition having the properties required of the bulk is then cast against the original film before the latter dries in the mold. This process, termed "dilaminar" film casting, yields laminated films having resistant surface layers of uniform, controllable thickness that are bonded to the substrate. The properties of a series of butyl acrylate-acrylonitrile copolymers of varying monomer ratios and amounts of organic reinforcing agents were studied. It was found that unreinforced copolymers of approximately 27 to 30% acrylonitrile had suitable resistance to staining and abrasion, while reinforced compositions of an elastomer copolymer having an acrylonitrile content of about 10% displayed optimum bulk but poor surfaee properties. Dilaminar films were cast of two compositions having optimum properties for surface and substrate layers. The laminated films retained the surface resistance of the outer laminae and exhibited mechanical properties intermediate between the properties of the two components. Equations relating tensile and flexural properties of laminated elastomeric films to those of the single monogeneous compositions were derived, and calculated tensile and flexural values were found to agree with the experimental data.

Testing

Hardness tests for plastics. W. Gohl. Kunststoffe *46*, 139-43 (Apr. 1956). Hardness is a very important property of plastics, but there are no practical test methods available for this property. After a thorough comparison of the spherical and pyramidal test procedures it was found that a 5-mm. sphere is the best suited means to determine the hardness of plastics. A new simple method was developed in which the penetration depth, *t*, is measured after 60 seconds. The load is selected so that *t* is within the range $0.15 = t = 0.35$ millimeter. The method requires four loads, namely 10, 25, 50, and 100 kg. to obtain this range. A preload of 1 kg. is recommended.

Vibrating reed test for plastics. S. Strella. A.S.T.M. Bulletin No. 214, 47-50 (May 1956). A new vibrating reed method for obtaining the dynamic modulus of plastics is described

Chemistry

Some factors involved in the preparation of uniform particle size latexes. J. W. Vanderhoff, J. F. Vitkuske, E. B. Bradford, and T. Alfrey, Jr. J. Polymer Sci. *20*, 225-34 (May 1956). Some factors involved in the preparation of monodisperse polymer latexes by seeded emulsion polymerization are discussed. In this technique monomer and catalyst are added to a previously prepared latex; during the subsequent polymerization these seed particles grow to a larger size. A mathematical analysis is developed relating the particle volume increase to particle size as a power function. Competitive particle growth is determined experimentally by polymerizing monomer in a seed latex comprised of a mixture of two monodisperse latexes of different sizes. In these experiments the diameters of the smaller particles increase at a slightly greater rate than those of the larger ones. Therefore the final particle size distribution is narrower than that of the seed latex. In these growth experiments the concentration of emulsifier is also important. An illustrative example shows that excessive emulsifier initiates *new* particles and insufficient emulsifier causes coagulum.

Polymerization of vinyl monomers by the cold mastication of rubber. D. J. Angier and W. F. Watson. J. Polymer Sci. *20*, 235-250 (May 1956). The rupture of natural and synthetic rubber molecules into free radicals by the shear imposed during cold mastication under nitrogen initiates the polymerization of monomers incorporated in the rubber. Experimental results on the polymerization of a range of monomers is reported. The polymer formed is mainly attached to the rubber, forming with it either a soluble interpolymer or a two-component gel depending on the monomer used. Results on the copolymerization of two monomers are also presented and interpreted.

Publishers' addresses

Acta Chemica Scandinavica: Biokemiska Institutet, Odengatan 63, Stockholm Va, Sweden.

A.S.T.M. Bulletins: American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.

British Plastics: Iliffe and Sons, Ltd., Dorset House, Stamford St., London S. E. 1, England.

Chemical Engineering Progress: American Institute of Chemical Engineers, 120 E. 41st St., New York 17, N. Y.

Chemical Week: McGraw-Hill Publishing Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.

Materials and Methods: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Modern Machine Shop: Gardner Publications, 431 Main St., Cincinnati, Ohio.

Oil and Gas Journal: Petroleum Publishing Co., 211 S. Cheyenne St., Tulsa 1, Okla.

Paper Trade Journal: Lockwood Trade Journal Co., Inc., 15 W. 47th St., New York 36, N. Y.

Plastics Institute Transactions and Journal: Plastics Institute, Aldelphi, Adams St., London W. C. 2, England.

U.S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each

Resin. E. W. Lindsay and F. A. Yeoman (to Westinghouse). U. S. 2,743,309, Apr. 24. Thixotropic unsaturated alkyd resin compositions.

Polymers. D. W. Chaney and R. L. Schaefer (to Chemstrand). U. S. 2,743,994, May 1. Shaped polymeric materials.

Plasticizers. C. P. Albus and D. E. Sargent (to General Aniline). U. S. 2,744,025-6, May 1. Cellulose esters plasticized with polyesters of suberic acid.

Laminates. H. A. Pace (to Goodyear). U. S. 2,744,042, May 1. Foamed isocyanate resin laminate.

Laminate. H. A. Toulmin, Jr. (to Midland Chemical). U. S. 2,744,044, May 1. Laminate for building structures.

Polymers. C. W. Theebald (to Du Pont). U. S. 2,744,074, May 1. Polymeric organic aluminum oxides.

Foam. W. J. Roberts (to Goodyear). U. S. 2,744,075, May 1. Expanded polyvinyl chloride.

Polyesters. J. R. Caldwell (to Eastman Kodak). U. S. 2,744,078, May 1. Polyesters from *p,p'*-sulfonyl dibenzoic acid.

Acrylonitrile. E. L. Ringwald and A. B. Craig (to Chemstrand). U. S. 2,744,081, May 1. Acrylonitrile polymers.

Polymerization. W. J. Arey, Jr. (to Esso). U. S. 2,744,084, May 1. Olefin polymerization.

Polyesters. M. D. Snyder (to Du Pont). U. S. 2,744,087, May 1. Polyester.

Polyesters. J. R. Caldwell (to Eastman Kodak). U. S. 2,744,088-9-90-1-2-3-4-5-6-7, May 1. Polyesters.

Copolymers. R. S. Towne (to General Aniline). U. S. 2,744,098, May 1. Copolymers of vinyl compounds with α, β-unsaturated dicarboxylic acids.

Molding. N. Fienberg and A. R. Calder (to A. C. I. Plastics). U. S. 2,744,288, May 8. Compression molding apparatus.

Porous articles. F. Stastny and K. Buchholz (to Badische Anilin). U. S. 2,744,291, May 8. Porous shaped thermoplastic articles.

Footwear. A. J. Gerber (to Gerber Plastic). U. S. 2,744,340, May 8. Molded plastic footwear.

Fiber treatment. R. F. Caroselli (to Owens-Corning). U. S. 2,744,835, May 8. Treating glass fibers with a vinyl copolymer and a Werner complex.

Coating. R. Schubert and G. Otto (to Badische Anilin). U. S. 2,744,836, May 8. Acrylic ester coating for leather.

Polyethylene. F. Cassis and C. R. Greene (to Standard Oil). U. S. 2,744,841, May 8. Removing polyethylene from a metal surface.

Resin. H. Rudoff (to General Electric). U. S. 2,744,845, May 8. Chlorinated maleic adduct ethoxyline resin.

Laminate. D. C. Stickles (to Victory Plastics). U. S. 2,744,846, May 8. Laminated protective structure.

Cellular material. F. W. Thomas and E. Simon (to Lockheed). U. S. 2,744,875, May 8. Cellular phenolic resins.

Plasticizer. C. W. Smith (to Shell). U. S. 2,744,877, May 8. Vinyl polymer plasticized with esters of 1,5-pentanediols.

Resins. R. Smith-Johannson (to General Electric). U. S. 2,744,878, May 8. Elastic organopolysiloxanes.

Stabilizer. J. G. Hendricks and L. M. Kebrick (to National Lead). U. S. 2,744,881, May 8. Vinyl halide resin stabilized with lead dicarboxylates.

Polyamide. I. P. Hammer and J. B. Rust (to Montclair Research and Ellis-Foster). U. S. 2,744,883, May 8. Water-soluble N-dialkyl-aminoalkoxymethyl polyamide.

Polymerization. T. F. Protzman (to Rohm & Haas). U. S. 2,744,886, May 8. Acceleration of polymerization of acrylates.

Molding composition. R. H. Sonneborn and F. W. Dennen (to Owens-Corning). U. S. 2,745,491, May 15. Fibrous glass-reinforced molding compositions.

Resin. R. Dijkstra (to Hartford National Bank). U. S. 2,745,816, May 15. Phenol-furfural resin.

Stabilizers. G. P. Mack and E. Parker (to Carlisle Chemical). U. S. 2,745,819-20, May 15. Organo-tin stabilizers for chlorinated resins.

Polymers. G. W. Stanton and F. A. Ehlers (to Dow). U. S. 2,745,821, May 15. Acrylonitrile polymers stabilized with alkyl esters of thioglycolic acid.

Polymerization. J. A. Melchore (to American Cyanamid). U. S. 2,745,824, May 15. Polymerization of styrene and acrylonitrile.

Polymerization. H. Wenning (to Chemische Werke Huls). U. S. 2,745,825, May 15. Polymerization of acrylonitrile.

Polyethylene. W. H. Kreidl (to Traver Investments). U. S. 2,746,084, May 22. Treating a polyethylene surface for printing.

Cellular bodies. H. Lindemann and E. Stirnemann. U. S. 2,746,088, May 22. Cellular thermoplastics.

Reinforced plastics. H. C. Thompson (to L-O-F Glass Fibers). U. S. 2,746,896, May 22. Glass-reinforced plastics.

Cellular articles. A. Cooper and L. B. MacQueen (to Expanded Rubber). U. S. 2,746,940, May 22. Expanded vinyl copolymers.

Copolymers. J. H. Sample and R. A. Sturges (to Sherwin-Williams). U. S. 2,746,942, May 22. Esters of copolymers of an unsaturated acid with a vinyl aromatic and an alkoxy polysiloxane.

Polymers. J. E. Pritchard (to Phillips Petroleum). U. S. 2,746,943, May 22. Emulsion polymers.

Copolymers. M. Naps and F. E. Condo (to Shell). U. S. 2,746,944, May 22. Vinyl halide copolymers.

Polymers. F. T. Buckley (to Monsanto). U. S. 2,746,945, May 22. Modified polyvinyl acetals.

Stabilizers. E. L. Weinberg and H. E. Ramsden (to Metal and Thermit). U. S. 2,746,946, May 22. Organotin sulfides to stabilize vinyl halide resins.

Pipe. C. De Ganahl. U. S. 2,747,616, May 29. Reinforced plastic pipe.

Resins. A. L. Allewelt (to American Viscose). U. S. 2,748,010, May 29.

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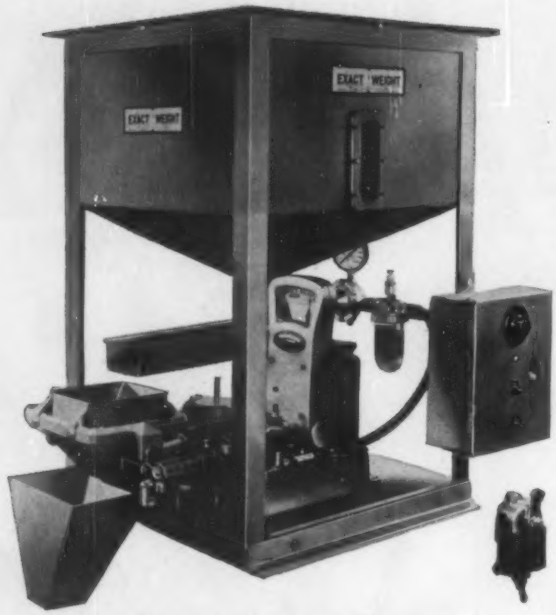

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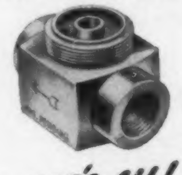

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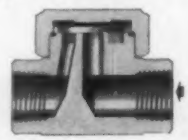

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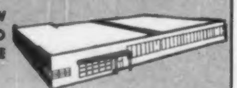

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Reaction products of cellulose thiourethanes and acrylic acid derivatives.

Polymerization. T. Kominami and J. Ukita (to Omni Products). U. S. 2,746,947, May 22. Polymerization of vinyl acetate.

Forming. R. B. Koch and R. E. James, Jr. (to Polymer). U. S. 2,747,224, May 29. Forming elongated plastic shapes continuously.

Reinforced resin. H. M. Richardson (to Atlas Powder). U. S. 2,748,028, May 29. Fibrous glass mat.

Agitator. W. L. Kelly. U. S. 2,748,045, May 29. Molded washing machine agitator.

Structural member. A. W. Russell (to Russell Reinforced Plastics). U. S. 2,748,048, May 29. Plastic reinforced structures.

Resins. J. H. Daniel, Jr. and R. T. Corkum (to American Cyanamid). U. S. 2,748,092, May 29. Modified alkyd resin.

Lacquers. H. Krzikalla and F. van Taack-Trakranen (to Badische Anilin). U. S. 2,748,094, May 29. Naphthalene-formaldehyde resin lacquers.

Polymers. H. J. Passino (to M. W. Kellogg). U. S. 2,748,098, May 29. Plasticized tetrafluoroethylene.

Filler. W. M. Bruner and P. J. Wayne (to Du Pont). U. S. 2,748,099, May 29. Polyamides with metal fillers.

Resin. H. M. Shappell (to Carbide and Carbon). U. S. 2,748,101, May 29. Water-soluble phenolic resin.

Polyurethanes. G. Danmiller (to Badische Anilin). U. S. 2,748,102, May 29. Polyurethanes from tri- or tetra-functional reactants.

Copolymers. W. J. Priest (to Eastman Kodak). U. S. 2,748,103, May 29. Copolymers of vinyl esters with N-allyl urethanes.

Ethylene polymers. W. Becker and O. Bayer (to Farbenfabriken Bayer). U. S. 2,748,105, May 29. Chlorinating polyethylene.

Polymerization. R. A. Scheiderbaner and L. S. Pitts (to Du Pont). U. S. 2,748,106, May 29. Ethylene polymerization.

Cellulose derivatives. A. L. Allewelt (to American Viscose). U. S. 2,748,109-10-11, May 29. Thiourethanes of cellulose derivatives.

Hollow articles. T. W. Winstead (to Hedwin). U. S. 2,748,401, June 5. Extruded hollow articles.

Liner. T. W. Winstead (to Hedwin).

U. S. 2,748,675, June 5. Plastic liner for composite containers.

Pipe. T. W. Winstead (to Hedwin). U. S. 2,748,805, June 5. Reinforced plastic pipe.

Molds. T. W. Winstead (to Hedwin). U. S. 2,749,294, June 5. Molds for thermoplastics.

Polymethylene. R. C. Osthoff and S. W. Kantor (to General Electric). U. S. 2,749,318, June 5. High molecular weight polymethylene.

Cellulose derivative. W. B. Hewson (to Hercules). U. S. 2,749,319, June 5. Cellulose acetate sorbate.

Alkyd. N. Spellberg (to Sherwin Williams). U. S. 2,749,320, June 5. Short oil styrenated alkyd.

Coating. K. J. Lissant (to Petrolite). U. S. 2,749,322, June 5. Polyfuran coating.

Resins. H. A. Walter (to Monsanto). U. S. 2,749,324, June 5. Pyrimidine-aldehyde resins.

Polymer blends. A. B. Craig (to Chemstrand). U. S. 2,749,325, June 5. Blends of acrylonitrile and other polymers.

Siloxanes. A. Hirsch (to Diamond Alkali). U. S. 2,749,326, June 5. Moldable siloxanes.

Polymers. R. W. Martin. (to General Electric). U. S. 2,749,327, June 5. Reaction products of dihydric alcohols and polymethylol benzenes.

Plasticizers. J. L. Ludlow (to Du Pont). U. S. 2,749,329, June 5. Polyester plasticizers.

Polyamides. D. S. Breslow (to Hercules). U. S. 2,749,331, June 5. Linear polyamides.

Shaping. R. L. Nowak (to Van Brode Milling). U. S. 2,749,572, June 12. Shaping thermoplastic sheets.

Extrusion. H. M. Gersman. U. S. 2,750,034, June 12. Extrusion apparatus.

Sheets. M. E. Latham (to Swedlow). U. S. 2,750,320, June 12. Continuous plastic sheets.

Resin. J. F. Bunnett (to U. S.). U. S. 2,750,347, June 12. Phenol-formaldehyde polymer of tyrosine derivative.

Resin. D. H. O'Herren (to RCA). U. S. 2,750, 349, June 12. Polystyrene-terphenyl compositions.

Polymerization. A. E. Kroll (to Du Pont). U. S. 2,750,350, June 12. Dispersion polymerization of tetrafluoroethylene.

New Machinery and Equipment*

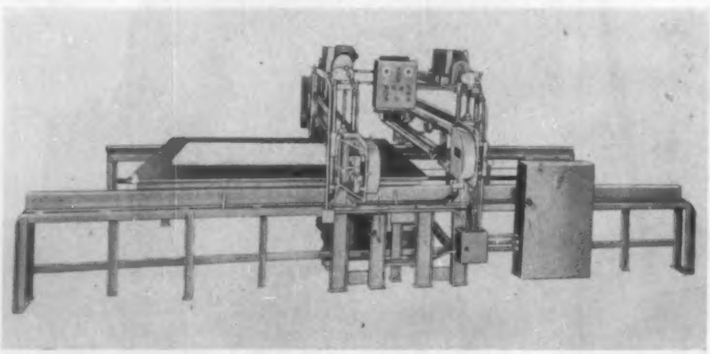
Extra-sensitive Beta-ray gage

Beta gage model BG-7 uses radioactive krypton to gain greater sensitivity than earlier gages using cesium and other sources. Particularly useful in gaging light sheet materials, the gage offers a maximum sensitivity of 1 mg./sq.cm. (about 10% in a 4-mil plastic film). The krypton source is sealed in a stainless steel container. Should the container be ruptured, the gas would quickly diffuse in the air. For this reason it is felt that the radioactive gas source is less of a personnel hazard than the solid sources. *Tracerlab, Inc., 130 High St., Boston 10, Mass.*

Leveller-splitter for foam

A leveller and splitter with two cutting heads is meant for cutting polyurethane and polyvinyl foams. It levels and splits stock to ⅛ in. or less and can handle slabs 7 ft. wide and up to 13.5 ft. long. The splitting action is practically continuous on this machine, which is equipped with a reciprocating table. A cut is made by one of the two heads as the table moves the stock in either direction. An abrasive covering on the table, together with double compression rollers in each head, hold the sheet firmly on the table and accurately control the depth of cut. Tables are available in four width/length combinations up to the given maximum, and can be traversed at speeds ranging from 11 to 44 ft./min. *Falls Engineering and Machine Co., Cuyahoga Falls, Ohio.*

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.



Falls Engineering machine for levelling and splitting plastics foams can handle slabs 7 ft. wide and up to 13.5 ft. long

Carbide router bits

A completely new line of carbide bits for routers that are said to withstand shock and resist breakage for longer life features a high "hook" angle on the new bits which eliminates pushing to give a smoother, faster, chip-free cut. These carbide bits are built on high-speed steel shanks, hardened to 55-60 Rockwell C, and the web leading to the router flutes is tapered to minimize notch effects. The bits will cut all plastics, woods, and composition materials. *Radial Cutter Mfg. Corp., 831 Bond St., Elizabeth 4, N.J.*

Traveling cut-off saw

Like others of its kind, this new saw travels with the extrudate it is cutting, thus guaranteeing a square cut. It can make up to 30 cuts per min. and can handle extrudates up to 4 in. wide or deep. It is particularly useful in cutting extruded pipe to length. *The Rainville Co., 2415 W. Hellman Ave., Alhambra, Calif.*

Three-color flexographic press

A 3-color, drum-type flexographic press especially designed for use with pressure-sensitive tapes and other materials that require support for multi-color printing, can print widths up to 10 inches. Its built-in flexibility permits a wide variety of printing, perforating, and slitting operations. It is equipped with an "unwind" for pressure-sensitive tape, a pull section, a reverse-printing unit, three face-printing units with inter-color driers and an over-all drier. The slit and product can be rewound on two separate spools. The hot-air drying system comes with the machine. *Inta-Roto Machine Co., Inc., Richmond, Va.*

Bench-type punch press

Model B-5, a 5-ton punch press, will perform up to 280 operations per min. on continuous punching, shearing, blanking, etc., in plastics, fiber, metal, or any workable material, within the rated 5-ton capacity. Its 65-lb. flywheel assures ample power for heavy-duty operations; it is V-belt driven by a ⅓-hp. motor. The new press has many construction features that insure accurate, long-lasting alignment. It is equipped with a synchronized clutch of simple and rugged design. All contacting parts have been heat-treated to high hardness. The standard stroke is 1.25 in.; others from ¼ to 2 in. are available. Motor is not included. *Alva Allen Industries, 1001-1015 N. Third St., Clinton, Mo.*

Non-indicating controllers

The 150 series Amplitrol controllers are potentiometer-type units with scales to show the "set" point of the quantity under control; but there is no scale to show the actual value of the quantity. The Model 151 is a simple "on-off" controller suited for those applications where lag and dead time can be made very small;

MODEL
H-250

VAN DORN

Step Up Production with 2½ Oz. Automatic Press

Check these outstanding features of this ultra-modern Van Dorn injection press:—

GREATER CAPACITY— Up to 2½ oz.; smaller pieces at faster cycles.

HI-SPEED PERFORMANCE— Plasticizes material at 22 lbs. plus per hour.

FASTER PRODUCTION—Will attain up to 720 cycles per hour (dry run).

HIGHEST EFFICIENCY—Due to water cooling of injection plunger, transfer hopper and oil cooler.

ACCESSIBILITY—Due to simple platen clamp device for purging to change material or color.

MORE SAFETY—Mold hydraulic mechanism makes press non-operative unless molded part is completely ejected.

SIMPLER OPERATION—Due to automatic, adjustable material metering device.

MULTIPLE OPERATIONS—Minimum operator attention by use of larger hopper and light that indicates when press needs attention.

SELECTIVE CONTROL—Merely throw toggle switch to operate press semi-automatically.

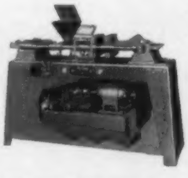
DEPENDABILITY— Because of all-steel construction and Van Dorn's established reputation in the plastics machinery field.

THE VAN DORN IRON WORKS CO.
2687 East 79th Street • Cleveland 4, Ohio
Cable Address: "VANDORN" Cleveland

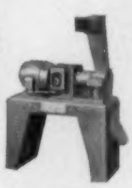
and this Van Dorn model is the lowest priced press in its class!

Write for complete data on Model H-250 and other equipment shown. FINANCING AVAILABLE

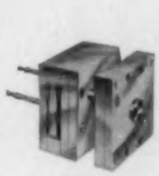
SEMI-AUTOMATIC PRESS
2-oz. capacity.



POWER OPERATED, LEVER CONTROLLED PRESSES
2-oz. and 1-oz. models



PLASTIC GRINDER
Grinds up rejects, waste, etc., for re-use.



MOLD BASES
Available from stock.

the Model 152 is an "anticipatory" proportioning controller that shuts off (or turns on) the control device a little before the set point is reached. Sensitivity is 75 microvolts for all scale spans; contact rating is 6 amp. at 115 v. a.c. These instruments are compact, the over-all dimensions being 7.6 in. wide by 7.8 in. deep by 8.1 in. high. A built-in voltage regulator eliminates the usual need for standardizing the potentiometer circuit. Automatic cold-junction compensation for use with thermocouples is standard with both instruments. *Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill.*

Sheet forming machine trims

Vac-Trim Model 246 is a sheet thermoforming machine that performs many of the common sheet forming operations and also trims the formed sheet before it leaves the frame. The trimming is done as a final step by heated trimming dies. The depth of draw of the Model 246 is 9 in., its maximum mold area is 24 by 24 in., it has a sandwich-type heater that heats both sides of the sheet, and it is equipped with a 2-hp., 28-cu. ft./min. vacuum pump. Six instant-reset timers can be set up for either automatic or manual control.

Vacuum Forming Corp. Model 246 forms and trims

Also available is the Vac-Trim Model 486, similar to the 246 but larger. It can handle molds up to 48 by 24 inches. Models handling other mold areas will be constructed to order. *Vacuum Forming Corp., 76 S. Bayles Ave., Port Washington, N.Y.*

Screen printing machine

An air-operated, electrically controlled, silk-screen printing machine speeds up the process. With various fixtures the machine will automatically print flat articles or cylindrical ones. The Model 90S gives heavy ink deposit with fine detail, even coverage of large areas. Maximum imprint size is 5.5 by 7.5 in. on flat surfaces; cylinders from 1.5 to 4 in. in diameter can be handled with a maximum circumferential print of 5.5 in. and axial print of 7.5 inches. With manual loading and unloading, up to 20 pieces/min. can be printed. *Markem Machine Co., Keene 57, N.H.*

Portable high-vacuum pump

Designed to reach pressures as low as 0.000001 mm. Hg, a new mobile pumping system consists of a 4-in. fractionating diffusion pump with a 15-cu. ft./min., two-stage backing mechanical pump. All components are mounted on a base with locking wheels and pull handle. The unit needs 115-v. a.c. and cooling water to operate. It is recommended for exhausting 10 to 15-cu.ft. chambers for impregnation, metallizing, degassing, etc. *Kinney Mfg. Div., The New York Air Brake Co., Boston, Mass.*

314-ton hydraulic press

A big press for compression and transfer molding is entirely automatic. Opening and closing speeds may be adjusted from 50 to 300 in./min. (fast travel) and from 1 to 10 in./min. (slow travel). Cycle controllers on the press include automatic breathing and knockout. *Erie Engine and Mfg. Co., Erie, Pa.*

25-ton automatic compression molding machine

Model 725, a fully automatic, air-operated compression press, is specifically intended as a low-cost unit for short production

F. J. Stokes Model 725 compression press is a low-cost unit for short runs

runs. Specifications are as follows:

Capacity, tons	25
Press stroke, in.	5
Ejection stroke (top and bottom), in., max.	2½
Hold-down pin stroke, in., max.	1¼
Daylight (press open), in.	22½
Daylight (bed plate to ram with press closed), in.	12 to 17
Platen area (left to right and front to back), in.	11½ by 6
Minimum dry cycle time, sec.	5
Over-all height, in.	84
Floor space (left to right and front to back), in.	29 by 36
Gross weight, lb.	1100

Model 725 can be equipped with a universal chase plate that permits cavities to be changed quickly without taking the plates from the press. It has an adjustable, rotary, three-station feeder and a cam-actuated air-ejection system for either top or bottom ejection. Cycles are easily adjusted to take care of bumping, breathing, and multiple air blasts. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

Automatic compression press

First of a new line of fully-automatic presses is the 75-ton Model 450-B. This press is equipped with a flexible feeding mechanism that permits feeding controlled amounts of powder from 1 to 2 cu. in. per station for different-size mold cavities. The output of several of the 16 stations can be

(*To page* 204)


Non-Whitening
Non-Scratching
Non-Crazing
Keep quality up with higher loadings of Super Multifex®
Actual use and rugged tests show vinyl compounders can profitably use Super Multifex in loadings as high as 70%. Even at this healthy proportion, DIAMOND'S calcium carbonate helps vinyl resist abrasion more successfully than ground limestone.
This ultra-fine particle filler produces less whitening when your vinyl is bent or scratched. SUPER MULTIFEX has a very uniform particle size — about 0.03 micron — and a double coating with two different agents to aid its dispersion.
Using high loadings of SUPER MULTIFEX, you can maintain your present quality standards — at less cost. Or boost quality at no extra cost.
Your nearby DIAMOND sales office can show you money-saving formulas and detailed cost comparisons. Or write to DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 14, Ohio.
Diamond Chemicals
Sales offices: New York, Philadelphia, Pittsburgh, Cleveland, Cincinnati, Chicago, St. Louis, Memphis, Houston.
Diamond distributors: Carmona & Hawxhurst, San Francisco; Dorsett & Jackson, Los Angeles; Van Waters and Rogers, Inc., Seattle and Portland, U. S. A.; Harrisons & Crosfield (Canada) Ltd.

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The new model M & M Dicer cuts perfect cubes from sheets up to ⅛" thick at speeds up to 85' per minute. Pellet shape of the notched knife dicer can be changed by adjustment of the feed roll speed. Straight knives are used for cutting extruded rods. Straight feed for better stock control. Available in three sizes to cut up to 6", 10", and 14" width plastic ribbons. Enquiries welcomed on larger capacity machines, too.

MITTS & MERRILL 86

1016 South Water Street • SAGINAW, MICHIGAN

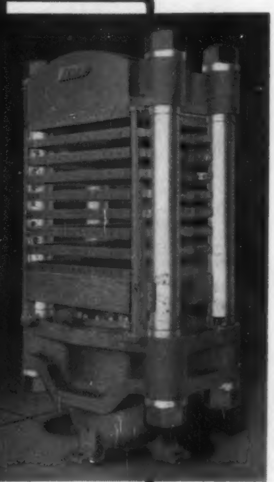
ERIE ENGINE & MFG. CO.

builds a complete line of HYDRAULIC PRESSES . . .

Designed and Engineered for

RUBBER and PLASTICS PROCESSING

REINFORCED PLASTICS MOLDING



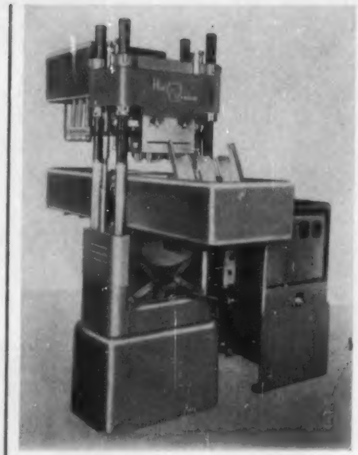
EEMCO heavy duty hydraulic presses for compression or transfer molding, laminating and polishing, and reinforced plastics molding are furnished with or without self-contained pumping units and special modifications. They are manufactured in all sizes from small laboratory presses to the largest sizes to suit any requirement.

Investigate EEMCO's complete line of Hydraulic Presses. Our engineers will gladly assist in solving any "Press Problems" you may have. Call or write today.

EEMCO **ERIE ENGINE & MFG. CO.**

12th St., & East Ave., ERIE, PA.

MILLS • PRESSES • LOADERS • LIFT TABLES • PLATENS • PREFORM MACHINES • ROVING CUTTERS



Hull-Standard Model 450-B compression press has flexible feeding mechanism

combined to fill larger cavities. A motor-driven take-off carriage passes a comb between knock-out pins, gathers the ejected parts, and transfers them to a receptacle. These automatic features are said to make it possible for one man to handle as many as ten machines. Specifications are:

Top closing speed, sec.	2.9
Top opening speed, sec.	2.7
Platen stroke, in.	7
Die area, in.	18 by 18.8
Dry cycle time, sec.	12

The press is also equipped with a "slow close" adjustment that increases the closing time to accommodate the slower-softening materials. *Hull-Standard Corp., Abington, Pa.*

Bayonet thermocouples

Recent advances in designs of miniature bayonet-type thermocouples include a wider variety of immersion lengths, adapters, lead wires, and terminal fittings (including quick-coupling plug types). These couples are used widely in plastics extruders and molding machines. Available in copper-constantan, iron-constantan, and chromel-alumel with three temperature ranges between −300 and +1400° F., the couples are encased in stainless steel. A new Ceramo construction of inert metal oxide insulation with a metal sheath makes possible couples with diameters as small as $1/16$ inch. *Thermo Electric Co., Inc., Saddle Brook, N. J.*

Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Polyesters and Their Applications"

By Johan Bjorksten, Henry Tovey, Betty Harker, and James Henning

Published in 1956 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 618 pages. Price: $10.00.

Claimed to be the first comprehensive survey of the entire polyester field from raw materials to fabricated products, this book contains, in addition to detailed text, an annotated bibliography of over 3300 references to patents and literature. Included in the general discussion are not only the unsaturated polyesters used in molding, casting, coating, impregnating, and laminating, but also the saturated polyesters used in the production of fibers, films, elastomers, and foamed plastics.

"Die Kunststoff-Industrie der Schweiz"

Published in 1955 by Verlag fur Wirtschaftsliteratur GmbH, Zurich, Switzerland. 148 pages. Price: $4.00.

This directory, written in both French and German, contains lists of plastics producers, processors, manufacturers, etc., in Switzerland. Leather - working and watch-making firms using plastics are also listed. English-German-French glossaries are included.

"Le Commerce des Matieres Plastiques dans le Monde"

By Jean Delorme

Published in 1956 by Les Editions Amphora, 119 Avenue Parmentier, Paris XI, France. 378 pages.

The history of the development of the plastics industry and the present status of that industry in practically every country of the world is presented in this book. Seven parts cover Europe, North America, Central America, South America, Africa, Asia, and Oceania (Australia and New Zealand). The Africa section, for example, deals with Algeria, Tunisia, Morocco, French Africa, Belgian Congo, Egypt, Ethiopia, Liberia, and Union of South Africa. The chapters on the major plastics-producing countries include information on production statistics, exports and imports, major producers of materials and machines, plastics organizations, publications, fairs and expositions, and helpful comments on rules and regulations pertaining to importing and exporting.

"France Plastiques"

Published in 1956 by Societe de Creations Editions et Productions Publicitaires, 27, Rue Laffitte, Paris IX, France. 1026 pages. Price: 2700 F. (ca. $8.20).

This eighth edition of the annual yearbook covering the French plastics industry is a classified guide encompassing materials makers, machinery and equipment manufacturers, molders, and fabricators. Lists of importers and distributors are also included. Indices of trademarks, manufacturers' societies, educational institutions, and publications are given.

"Organic Chemistry"

By Louis Fieser and Mary Fieser

Published in 1956 by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. 1112 pages. Price: $10.00.

The third edition of this standard text on organic chemistry has been expanded to include, among other things, information on structures and total synthesis of important fatty acids, carbohydrates, peptides, enzymes, alkaloids, and antibiotics. Since new techniques have so increased the knowledge of biogenesis, the chapters dealing with the metabolism of fats, carbohydrates, and proteins have been completely revised.

Among the very recent developments introduced in the third edition are the structures of reserpine and vitamin B_{12} and the total synthesis of aldosterone. Also of interest is the inclusion of 454 brief biographical sketches of chemists associated with the developments cited.

"Resins-Rubbers-Plastics Yearbook 1955"

Edited by H. Mark, E. S. Proskauer, and V. J. Frilette

Published in 1956 by Interscience Publishers, Inc., 250 Fifth Ave., New York, N. Y. 1148 pages. Price: $35.00.

Representing a collection of abstracts of papers dealing with the properties of plastics, resins, and rubbers, the material in this volume was originally published in 1955 in periodicals in the United States and abroad. The editors point out that although the information is presented in the form of abstracts, they are far more complete than conventional abstracts; many of them contain original data, graphs, charts, photographs, etc. Authors, addresses, and original publication for each abstract is given.

"Check Lists of Sales-Promotion and Merchandising Essentials"

Published in 1956 by Printers' Ink Books, A Div. of Printers' Ink Publishing Co., Inc., Pleasantville, New York. 271 pages. Price: $4.95.

Containing 161 check lists, this book provides technical and administrative assistance to the sales-promotion and merchandising executive. Some of the subjects covered include: management activities, jobber relations, sampling, mail order, distribution theory and practice, point-of-purchase advertising, packaging, research, exhibits, etc.

Fluorescent pigments. Folder describes fluorescence, gives its history, and contains sample chips of available daylight fluorescent colors. *Luminous Resins Inc., 166 W. Washington St., Chicago 2, Ill.*

Building directory. The "Building Science Directory" contains an alphabetical listing of organi-

zations in the building industry which are sources of information and also gives details about research programs, publications, educational programs, standards or codes, etc. Loose-leaf sections are to be issued periodically. $2.00 a year. Free to participating members of *Building Research Institute, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.*

Silicone rubber. Brochure lists a line of silicone rubber and allied products available as stock items. Properties, brief descriptions, and price lists are included. 8 pages. *The Connecticut Hard Rubber Co., New Haven, Conn.*

Reinforced epoxy. Brochure contains information on temperature characteristics, electrical properties, weight, strength, etc., of fibrous glass-epoxy tubing. Data on A.S.T.M. testing procedures and suggested applications in the aircraft, electronics, chemical, petroleum, and food industries are included. 4 pages. *Lamtex Industries, Inc., 51 State St., Westbury, L. I., N. Y.*

Vapor barrier materials. Report NAS 445 is the result of a study undertaken to evaluate methods of selection and use of vapor barrier materials with slab-on-ground construction and as ground cover in crawl spaces. Recommendations include vapor barrier requirements, test procedures, methods of proper installation, and suggestions for desirable research. $1.50 (free to BRI members). 23 pages. *Building Research Institute, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.*

Morpholine. Technical bulletin F-8640 describes N-substituted morpholine derivatives used as catalysts in the preparation of polyurethane foams, as stabilizers for chlorinated solvents, in the preparation of self-polishing waxes, oil emulsions, etc. Potential applications, physical and physiological properties, and shipping data are discussed. 4 pages. *Carbide and Carbon Chemicals Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Dresinol. Booklet details the properties contributed when this resin dispersion is used to modify GR-S, neoprene, natural rubber, and polyvinyl acetate. 9 pages of tabular matter are included. 18 pages. *Hercules Powder Co., Inc., Wilmington 99, Del.*

Vinyl stabilizers. Stabilizers designed to protect vinyl floor tile compositions, film, sheeting, extrusions, and plastisols against deterioration when exposed to light and heat, are described in new folder. 6 pages. *Metasap Chemical Co., Harrison, N. J.*

Chemicals. Booklet describes the uses of polyvinyl acetate emulsions, starches, flours, dextrins, and water-soluble gums in the food, medical, paper, textile, packaging, cosmetic, mining, ce-

ramic, and confectionary industries. 20 pages. *Paisley Products, Inc., 630 W. 51st St., New York 19, N. Y.*

Aluminum chloride. Product Development Bulletin AC-1 describes chemical and physical properties of anhydrous aluminum chloride used in the manufacture of organic chemicals, synthetic resins and rubber, gasoline, etc. Handling methods are suggested. 4 pages. *Solvay Process Div., Allied Chemical & Dye Corp., 61 Broadway, New York 6, N. Y.*

Pipe, valves, fittings. Corrosion resistance properties, fabricating characteristics, and availability of polyvinyl chloride pipe, fittings, and valves, are covered in Memorandum No. 13. 12 pages. *Peter A. Frasse & Co., Inc., 17 Grand St., New York 13, New York.*

PVC sheet standard. Commercial Standard CS201-55, issued by the Dept. of Commerce, covers physical and chemical requirements, and methods of test for rigid polyvinyl chloride sheets suitable for the fabrication of equipment and structures by hot-forming and welding techniques. A recommended method of declaring compliance with the standard is included. 10¢ 11 pages. *Superintendent of Documents, U. S. Govt. Printing Office, Washington 25, D. C.*

Abstracts. "British Plastics Federation Abstracts" gives digests of patents, publications, and articles pertaining to plastics and the plastics industry. Some of the subjects covered in the April, 1956 edition are: Raw Materials, Fillers, Plasticizers, Pigments, Thermoplastics, Thermosetting Plastics, Adhesives, Molding, Reinforced Plastics, Extrusion, Properties, Applications of Plastics, etc. 87 pages. Published monthly; £10.10 (ca. $28.28). *The British Plastics Federation, 47/48 Piccadilly, W.1, England.*

Polyethylene. Number 91 of "Kabelitems," "Recent Developments in Polyethylene Insulating Materials," discusses some of the characteristics of the low-pressure polymers and their implica-

tions for wire and cable uses. Charts and tables give properties. 16 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Hydraulic systems. Revised bulletin 900 describes how hydropneumatic accumulators can reduce size, complexity, and operating costs of hydraulic molding equipment. A section on how to find required accumulator capacity is included. 8 pages. *Greer Hydraulics Inc., New York International Airport, Jamaica 30, N. Y.*

Safety data. Two new safety data sheets give properties and essential information for the safe handling and use of anhydrous aluminum chloride (SD-62, 12 pages) and Toluene (SD-63, 20 pages). Included is material on shipping containers, storage, waste disposal, and health hazards and their control. 30¢ each. *Manufacturing Chemists' Association, 1625 Eye St., N. W., Washington 6, D. C.*

Plastics and synthetic fibers. Bulletin No. 23 gives a brief account of the most recent developments in plastics and synthetic fibers. Included is a general introduction to thermoplastic and thermosetting plastics, synthetic rubbers, and new synthetic fibers and textiles. A concluding section deals with raw materials. 4s. (ca. 56¢). 46 pages. *Museum of Applied Arts and Sciences, Harris St., Broadway, Sydney, Australia.*

Selling to GM. Booklet contains a directory of General Motors' manufacturing divisions with a list of civilian and defense products made by each. Key point of interest is the directory of GM purchasing departments which lists locations and types of products required. 28 pages. *General Motors Corp., 1775 Broadway, New York 19, N. Y.*

Vulcanized fibre, laminated plastics. Two bulletins cover physical properties, specifications, characteristics, and applications of vulcanized fibre (a converted cotton cellulose) and a family of

thermosetting high-pressure laminates. *National Vulcanized Fibre Co., Wilmington 99, Del.*

Structural adhesive bonding. Brochure lists advantages of adhesive bonding, describes its uses, and presents technical data on high-temperature adhesives developed for metal-to-metal and sandwich applications in the aircraft industry. 18 pages. *Narmco Resins and Coatings Co., 600 Victoria St., Costa Mesa, Calif.*

Silicone-glass. Physical and dielectric properties, "case-history" descriptions of specific electric and electronic applications, and a list of current manufacturers and fabricators of silicone-glass laminates are covered in new brochure. 4 pages. *Dow Corning Corp., Midland, Mich.*

Vinyl silo caps. How farmers can save money and silage with silos and silo caps made of vinyl is described in this booklet. Much of the material in the booklet is based on research conducted by Bakelite Co. in cooperation with Rutgers University's Dept. of Farm Crops. 8 pages. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 260 Madison Ave., New York 16, N. Y.*

Teflon. Brochure T-110 describes products fabricated from Teflon, gives information on properties and specifications, and presents operational and service data. 12 pages. *Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.*

Variable-speed drives. Bulletin 1600-B7 P contains information on operating principles, design, component parts, etc., for a line of variable-speed drives for a variety of uses. Specifications, selection tables, and engineering definitions and formulas are included. 16 pages. *Worthington Corp., Harrison, N. J.*

Correction. Item in Books and Booklets Section of the June issue of MODERN PLASTICS Magazine stated that American Society of Tool Engineers' 1956 Collected Papers are available at $4.50 to members. Actually they are available at $4.00 to members.

mp Plastics

Production and sales figures in 1000 lb.* for April and May 1956

Materials	*Total p'd'n first 5 mos. of 1956‡*	*Total sales first 5 mos. of 1956‡*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	8,020	8,097
Sheets, 0.003 gage and over	6,903	6,490
All other sheets, rods, tubes	3,394	3,183
Molding, extrusion materials	36,468	35,863
Nitrocellulose sheets, rods, tubes	2,599	2,352
Other cellulose plastics	2,454	2,256
Phenolic and other tar-acid resins:		
Molding materials[a]	101,443	86,538
Bonding and adhesive resins for:		
Laminating (except plywood)	27,896	19,051
Coated and bonded abrasives	6,997	6,969
Friction materials (brake linings, clutch facings, etc.)	8,714	7,609
Thermal insulation	23,735	24,005
Plywood	18,751	14,954
All other bonding uses	13,715	13,532
Protective-coating resins	13,353	11,372
Resins for all other uses	13,389	11,699
Urea and melamine resins:		
Textile-treating resins	21,143	18,345
Paper-treating resins	10,619	10,219
Bonding and adhesive resins for:		
Plywood	43,779	40,493
All other bonding and adhesive uses, including laminating	11,307	9,952
Protective-coating resins	16,208	11,475
Resins for all other uses, including molding	38,045	35,173
Styrene resins:		
Molding materials[a]	186,716	180,253
Protective-coating resins	42,049	40,866
Resins for all other uses	42,852	42,956
Vinyl resins, total[b]	324,636	298,999
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		32,928
Sheeting (resin content)		24,581
Molding and extrusion (resin content)		82,346
Textile and paper treating and coating (resin content)[c]		25,293
Flooring (resin content)		24,660
Protective coatings (resin content)		11,157
All other uses (resin content)		31,962
All other vinyl resins for:		
Adhesives (resin content)		15,613
All other uses (resin content)		50,458
Coumarone-indene and petroleum polymer resin:	103,245	100,745
Polyester resins:	30,006	26,309
Polyethylene resins:	213,619	200,965
Miscellaneous:		
Molding materials[a, d]	18,505	16,085
Protective-coating resins[e]	4,044	2,114
Resins for all other uses[f]	50,752	46,229

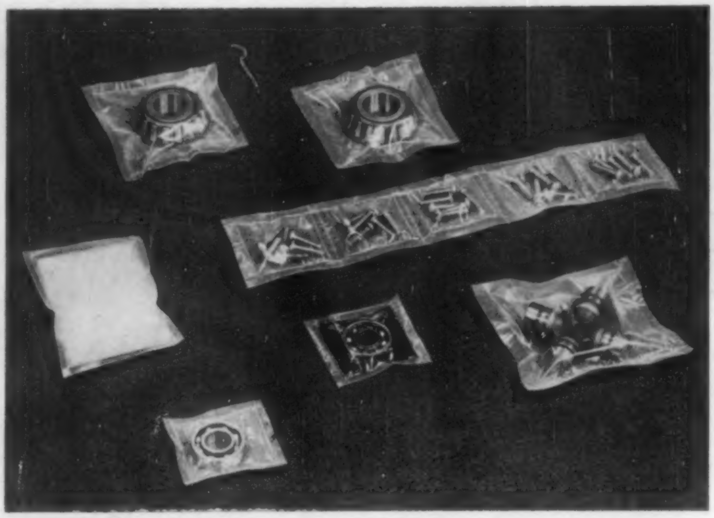
*Dry basis designated unless otherwise specified.
‡Partially estimated.
[a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by the U. S. Tariff Commission

April		May‡	
Production	Sales	Production	Sales
1,545	1,660	1,466	1,530
1,398	1,265	1,346	1,347
664	625	669	613
7,376	7,077	7,415	7,336
513	471	569	413
429	356	489	483
20,609	17,616	20,489	17,643
5,071	3,458	5,403	3,312
1,509	1,547	1,251	1,258
1,663	1,644	1,283	1,003
4,743	4,479	4,462	5,287
3,747	2,933	3,425	2,686
2,835	2,957	2,770	2,713
2,674	2,199	2,734	2,076
2,629	2,074	2,590	2,378
3,887	2,742	3,405	3,256
2,321	2,094	2,177	2,316
8,169	8,364	8,277	7,598
1,878	1,666	1,954	2,154
3,709	2,535	3,116	2,184
7,104	5,779	7,642	7,481
40,172	40,585	40,798	37,670
7,699	7,781	8,027	8,448
8,639	9,170	9,294	8,190
65,487	59,986	63,977	58,209
	6,247		5,948
	4,674		4,403
	15,560		16,470
	4,646		4,322
	4,494		5,075
	2,344		2,458
	7,295		6,087
	3,114		3,288
	11,612		10,158
20,344	20,170	20,966	20,238
5,855	5,778	7,289	6,887
42,205	38,783	46,710	41,549
3,372	2,822	3,706	3,100
697	389	1,143	502
10,530	9,482	10,803	9,531

are given. [c] Includes data for spreader and calendering-type resins. [d] Includes data for acrylic, nylon, and other molding materials. [e] Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f] Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.



Suggested for packaging a variety of items such as precision machine parts, lubricating oils, cosmetics, acids, etc., 4½-mil "heat-sealable polyester film" is produced in widths up to 22 inches

New polyester packaging film

A new clear plastic film—for packaging everything from acid to precision machine parts—has been announced by Minnesota Mining and Mfg. Co., St. Paul, Minn.

The film is described by the company as "a heat-sealable polyester film, produced 4½ mils thick and in widths up to 22 inches. It is currently selling for about 70¢ per sq. yd. (not lineal)."

It is further claimed by 3M that the film is the first durable packaging material which exhibits the strength and resistance to oil found in polyester films and the resistance to corrosive fluids and the heat sealable properties of polyethylene film. The film is also non-toxic, has excellent resistance to boiling and moisture and gas permeation, and exhibits "good" puncture resistance.

As such, 3M recommends the use of the material for dry or wet packaging of machine parts with critical surfaces (such as bearings, engine parts, and gear mechanisms), and for packaging most lubricating and food oils and oil-based products, cosmetics, drugs, and corrosive chemical agents.

The film is claimed to be heat sealable at 275 to 350° F., at 10 to 60 p.s.i. jaw pressure with a ½- to 2-sec. dwell. Its tensile strength is greater than 15 lb. per in. of width. Other physical properties which make the film so suitable for a wide range of packaging purposes include: a heat-seal seam strength of over 15 lb. per in. of width in peel, a burst strength (Mullen) of 48 p.s.i., clear transparency, dimensional stability, exceptional dielectric strength, resistance to deterioration under radiation, excellent fungus resistance, and printability.

The film, in lengths up to order, is being produced in limited quantities and will be supplied directly from the firm's St. Paul manufacturing plant on 30 days' delivery nationally.

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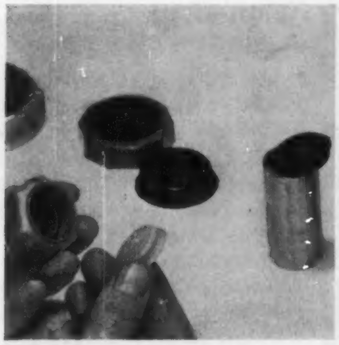


Vacuum formed polyethylene seals are plugged into open conduit ends

Formed plugs

To offset any possibility of plaster, paint, or other foreign matter clogging up open electrical conduits when construction work is going on, vacuum formed polyethylene protective seals are now being used to plug the open ends.

As a replacement for conventional rigid metal seals, many of which had to be applied at the factory, the resilient polyethylene plugs can easily be installed in the field, requiring only finger pressure to snap them into place in the ends of the conduits or bushings. Because of their flexibility, the plugs, which are available in 6 sizes from ½ to 2 in. in diameter, can be used on most any type of conduit (rigid or thin-walled) or bushing (metal or plastic) in a wider range of diameters than is possible with rigid metal seals. Unless the metal plugs are a perfect fit, they cannot be forced into the ends of the conduit or bushing.

The plastic plugs are vacuum formed of 40-mil polyethylene sheet on a commercial machine with a 24- by 36-in. bed. Three different-size plugs are formed at the same time on a multiple-cavity sprayed-metal male mold. Complete cycle, including loading and unloading, is about 2 minutes. After forming, the sheet is cut into strips, each containing a row of plugs, and the formed plugs are individually die cut.

Credits: Plugs formed by Preservation Packaging, Hillside, N. J., for The Thomas & Betts Co., Elizabeth, N. J.; polyethylene sheet from Celanese Corp. of America.

Nylon strip in window channel

A heavy extruded strip of low-friction, corrosion-resistant nylon applied to the bottom of a channel for sliding windows used in marine applications has lengthened the service life of the channels and has contributed to smoother window action.

The nylon strip, 0.040 in. thick and $\frac{15}{32}$ in. wide, is cut to size from long coils of extruded nylon. It is supplied without a camber in extra-length coils so that it can be continuously rolled into place in the bottom of the channel where it is intended to carry the weight of the window glass as it slides horizontally along its edge.

The nylon-bottomed channel itself is installed in grooves cut into the window sill. Brass screws or self-tapping fasteners (depending on wood or metal construction) are used to anchor the channel in place.

The core and trim bead of the channel into which the nylon strip is fitted are both of stainless steel. On top of the nylon strip is a water-repellent, piled fabric. Beneath the strip and separating it from the steel shell are a felt cushion and a heavy vulcanized rubber-covered core. Because of the felt pad and the rubber core, the heads of the installation screws can be drawn down into the nylon strip to allow smooth clearance for the edge of the glass window.

In addition to its low friction characteristics and the excellent wearing surface it provides, the nylon strip exhibits resistance to deterioration by both fresh and salt water. After 503,000 wear cycles on a special wear testing machine, and after exposure to salt spray for 1000 hr. in a subsequent test, the nylon showed no undue sign of wear or corrosion. Because of the nylon, the channel is expected to hold up for many years under the most severe service conditions.

Credits: StanPro window channel manufactured by Standard Products Co., Lexington, Ky.; Polyplenco nylon supplied by The Polymer Corp. of Pennsylvania, Reading, Pa.

Drum closures

By replacing metal with a threaded molded polyethylene plug, silicone emulsions shipped in phenolic-lined drums are now completely protected from contamination by rust.

The new closure consists of three parts: a molded polyethylene flange with internal threads and a protective diaphragm in its base (see photo below); a molded polyethylene plug with external threads; and a metal retaining ring. To seal the drum, the flange is first inserted into the drum opening; the metal locking ring, which fits over the flange, is clamped over the outer lip of the polyethylene using a special crimping tool and hydraulic pressure of approximately 1400 p.s.i. The plug is then screwed into the flange.

To gain access to the contents of the drum, the plug is unscrewed and the diaphragm cut out and removed from the flange. To reseal the drum, the plug is simply screwed back into the flange piece.

In addition to eliminating the rust problem, the new plug also prevents tampering, since the diaphragm has to be cut in order to get at the contents. In the event the plug is lost or removed, and for some reason not replaced, the diaphragm will protect the contents of the drum.

Credits: Polytheylene plug molded by Rieke Metal Products, Auburn, Ind. for Dow Corning Corp., Midland, Mich.

Polyethylene closure assembly consists of flange with integral diaphragm (right), plug (left), and retaining ring (rear center)

Adhesive-backed Mylar panels are expected to stimulate sales of batteries

Battery plaques

Immediate company identification for more effective merchandising, a neater appearance, and lower finishing costs are made possible through the use of a colorful identification panel for battery cases fabricated of Mylar polyester film.

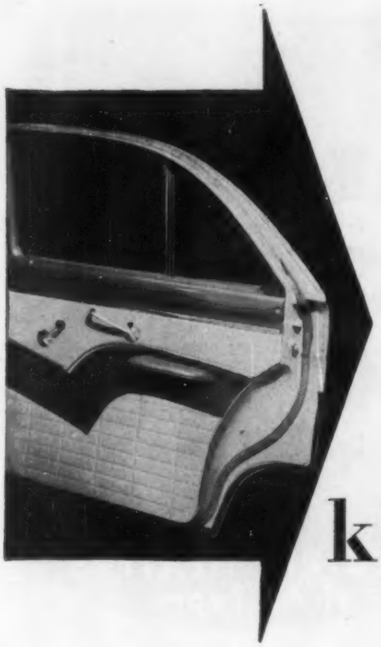
The flexible Mylar panels, backed up with a strong pressure-sensitive adhesive, can be printed in a wide variety of colors and may be die cut in various sizes to meet individual specifications for either front or end panels.

To apply the panels, the protective release paper is simply stripped off the adhesive side of the panel and the panel is pressed and smoothed into place on the battery case.

According to Stokes Molded Products Div. of the Electric Storage Battery Co., Trenton, N.J., who are using the technique, the durable, acid-resistant, colorfast Mylar film provides the manufacturer with a simple, clean, quick method of applying such information as model number, date of manufacture, instructions, etc., to the battery case—without any of the problems connected with conventional methods of gluing or "painting" identification medallions on the cases.

On dealers' shelves, the attractive appearance of the panels is also expected to stimulate battery sales.

Credit: Mylar polyester film supplied by E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.



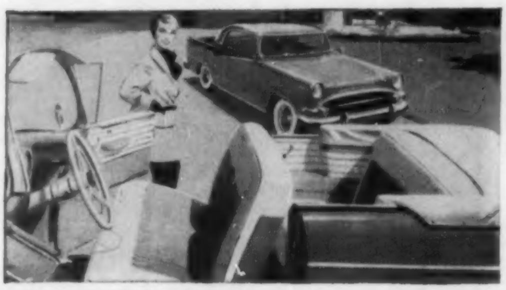
How a new kind of fabric opened the door to a new kind of car interior

and caused important changes in coating, laminating, and other plastics operations

Behind so many of today's high-fashion car interiors: Lantuck non-woven fabrics.

As an improved backing for vinyl upholstery, Lantuck helped make possible the brilliant new interiors conceived by the industry's leading designers, helped bring about many startling changes in upholstery textures and patterns.

But the unusual advantages of Lantuck are being recognized not only in coating, but also in laminating and "plumping" types of applications. If you're looking for ways to reduce production costs *and* improve product performance, look to Lantuck. For free copy of new book explaining the unique advantages of Lantuck non-woven fabrics, write Lantuck Dept. M9.



Some of the unique advantages provided by Lantuck

- Balanced tensile strength, tear and stretch characteristics in all directions, because of random distribution of fibers.
- High tear strength, excellent stretch and recovery.
- High gauge-weight ratio.
- Smooth surface, no show-through of weave pattern, excellent for embossing.
- Can be calender coated, laminated, or electronically sealed to vinyl film.
- Reduced number of specifications.
- Easier, neater tailoring.
- High impact strength, high fatigue resistance for laminates.
- Good bulking qualities in "plumping" and packing.
- Available in variety of natural and synthetic fibers and combinations.
- Wide range of widths, weights, gauges and densities.

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Swimming pools

Latest entry into the booming market now opening for low-cost backyard swimming pools is a portable, above-ground unit fabricated of vinyl-coated nylon fabric.

The new pools are available in square, rectangular, and circular shapes in sizes ranging from 42 by 66 in. (for a rectangular unit) to a 20-ft. diameter circular pool.

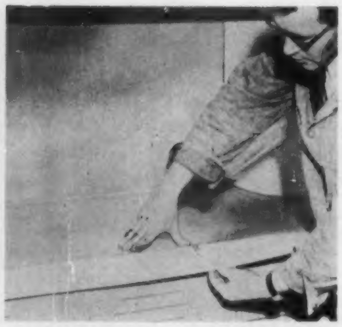
When filled with water, sides of the 20-ft. pool, which are about 3 ft. high, are supported by a wire screen and sturdy metal supports which are easy to assemble and dismantle. An ordinary garden hose fills the pool in about 14 hr. with a total of 7,000 gal. of water. Water is emptied from the pool by simply removing a cork plug located near the base.

The vinyl-coated nylon fabric, aqua blue in color, will not fade under exposure to sunlight; it is also resistant to wear and tear, and impervious to mildew, corrosion, etc.

Accessory equipment, such as ladders, sliding boards, and diving platforms, is available. The 20-ft. circular pool retails for approximately \$225.00. Smaller units are marketed at prices down to \$15.00.

Credits: Manufactured by Hettrick Mfg. Co., Toledo, Ohio.; Geon vinyl coating supplied by B.F. Goodrich Chemical Co., Cleveland, Ohio.; nylon material is coated by Electro Plastic Fabrics, Inc., Pulaski, Va.

Portable swimming pool, made of vinyl-coated nylon fabric, is 20 ft. in diameter and stands 3 ft. high



Flexible vinyl-polyester film laminate provides do-it-yourselfers with easy-to-install counter tops, backsplash areas

Counter tops

Sheets of rugged vinyl backed with textile fibers and surfaced with a layer of transparent Mylar polyester film are being offered to the "do-it-yourself" market as attractive, durable, easy-to-install flexible counter tops and backsplash areas.

The counter tops, which are virtually stainproof and will not crack, shatter, or flake, are available by the yard in widths of 27 and 46 inches. Their flexibility makes it feasible to install them in a continuous sheet across the counter, up the back wall or backsplash, and down over the front edge. They can be bent without cracking, are easily cemented in place, and may be installed with or without metal moldings.

According to recent laboratory tests, the material is claimed to have abrasion resistance equal to that of high-pressure laminates. It is also impervious to alcohol, fruit acid, and most staining agents; even ink, iodine, nail polish, etc., wipe right off. Since the film has no dirt-retaining pores, the surface is readily cleaned with ordinary soap and water.

The laminate is available in pearl and linen patterns in red, gray, green, charcoal, yellow, and buff. A colorfast material, it resists fading even under constant exposure to direct sunlight.

Credits: Bolta-Top manufactured by Bolta Products Div., The General Tire and Rubber Co., Lawrence, Mass.; Mylar supplied by Du Pont.

New press, new process

(*From pp. 106-109*)

Because the proper ratio of part thickness has to be maintained in sections made larger to provide strength where most needed, it was necessary to find a precise method of preforming.

Preforming and pouring

The accompanying cross-section sketch of a 54-in. bathtub shows the differences in wall thicknesses at various points. To achieve these thicknesses, the preforms are made of glass mat, tailored to measure; the body of the tub has two layers of mat, the beefed-up sections three or more to provide the same percentage of glass in the wall. The preforms are built up over an epoxy-surfaced male form and the preform table becomes the curing oven when a hood is lowered and clamped over it and the heat turned on. A unique cantilevered door is at the back of each individual press room; the preform builder places a number of preforms on this door and it is automatically closed, placing the preforms in a handy position for the press operator.

In operation, the white or colored gel coat is sprayed over the stainless steel male die, the preform placed in position, and the polyester resin poured on. The gel coat goes on at 170° F., as does the polyester. The female is then lowered on to the bushing stops, the vinyl baffle tube inflated, the vacuum pulled on the molding material, the vacuum cut off, and the rubber bag above the female inflated to bring full pressure on the material. The strain rods go through the four corner holes and are caught by the yokes, and the heat of the tools is automatically raised in 15 sec. to the required 240° F. Total press cycle is 15 minutes.

Air cylinders on the bushings help to break the molds apart. The pieces are removed and placed on a trimming saw, which is preset for trimming the lip edge at right angles to the material.

After molding, an isocyanate foam is cast on the tub base in a jig fixture, providing the unit with additional resilience and making possible level installation.

Needless to say, each press room is unitized with one low-pressure boiler for each, and with a supply of filtered fresh air provided.

Conclusion

The three engineering challenges mentioned earlier in this article have thus been achieved. The differential expansion and contraction with temperature changes in dissimilar materials has been brought under control. The press design makes it possible for the operator to take sufficient time to place the material before the full heat and pressure are turned on. The drawing of the vacuum on the molding material has made for a minimum of rejects.

Patent applications have been filed covering all phases of this development.—END

All-plastics interior

(*From* pp. 110-111)

necessary, they can be made directly on the panels while they are in place, or an entire panel can be removed and afterwards replaced.

In the fluorescent lighting system, fixtures consist of corrugated panels of translucent reinforced plastics snapped into place behind retaining bands formed from a vinyl-to-metal laminate. A sheet of silver-metallized Mylar polyester film adhered to the panel behind the fluorescent tubes serves as a reflector. The 40 ft.-candles of light provided at the reading plane by the lighting system eliminates the need for lights positioned along the baggage rack.

Large-volume markets

From the standpoint of potential value as a large-volume market for plastics materials, two of the most exciting developments incorporated in the design of the "Pioneer III" are the plastic seating and the bathroom unit.

The attractive bucket seats used in the car are molded in one piece of reinforced plastics and mounted on an aluminum seat base. To facilitate removal of the vinyl-coated upholstery, the fabric is attached by clip to the top of the seat and by a set of concealed straps to the bottom. Cushioning is fabricated of vinyl foam.

The entire bathroom unit, incorporating the walls, hopper, washbasin enclosure, mirror frame, light fixture holder, towel disposal unit, and towel dispenser, is also molded in one piece of polyester-fibrous glass laminate. The entire assembly can thus be mounted into the car as a single unit, prepiped and prewired. All piping, incidentally, with the exception of the pipe for carrying hot water from the electric water heater, is extruded of corrosion-resistant, flexible vinyl which will not burst even when frozen.

Reinforced plastics materials are also put to use in the design of the water tank (which is lined with epoxy), vestibule ceiling panels, exterior door inner pan-

els, the battery box, transition air ducts, the enclosure around the air conditioning unit, and the external exterior skirts.

In other areas of plastics applications, all interior partitions are of plywood faced with decorative melamine laminates—again requiring no paint and with a hard, wear-resistant surface. Vinyl tile covers the plywood floor and the space between the plywood floor and the corrugated steel undersurface is filled with isocyanate foam to provide insulation and additional sound deadening. The foam is generated in place during the construction of the car and also helps to support the wood floor and stabilize the floor sheathing. Isocyanate foam, again chosen for its sound deadening characteristics, also separates the air conditioning equipment from the car's interior paneling.

As a result of this extensive usage of plastics materials coupled with the development of a special lightweight truck, Budd has cut the weight of the car down to 52,330 lb.—or 595 lb. for each of the 88 passengers it will accommodate in its 85-ft. length. In contrast, a standard lightweight coach weighs 123,200 lb. or 1678 lb. for each of the 74 passengers it carries.

Savings in cost

Cost-wise, important savings were realized by molding the reinforced plastics parts as single pieces that required no subsidiary supporting structure, eliminated the need for molding and joints, and could be tooled up for at low costs. The one-piece designs, e.g. the pre-assembled bathroom unit, also facilitated assembly and installation—and, of course, in every instance where corrosion-resistant, scratch-resistant, easy-to-clean plastics are used, maintenance requirements are at a minimum.

The majority of large single reinforced plastics pieces for the car were produced by the hand lay-up technique (generally using fibrous glass mat supplied by Owens-Corning); where several pieces were required, for example seats, matched metal molding was used.—End

Film on the farm

(From pp. 112-116)

the row so that a skirt is left over on either side which can be weighted down by covering it with loose dirt. In Dr. Emmert's experiments at the University of Kentucky, he has been using 12-gage galvanized wire and 36-in. width polyethylene film to cover single rows, and 11-gage wire and 44- to 56-in. film widths to cover several rows at the same time. To form an insulating air space, he has used two layers of film, one placed loosely over the wickets, and the other film stretched taut over it.

Results with these new row-cover greenhouses have been excellent. Top quality lettuce and tomatoes have been grown two months earlier in the spring and two months later in the fall at Lexington, Ky., under plastic row covers. The out-of-season lettuce and tomatoes brought hothouse prices in the market. Produce managers bought the row-cover vegetables in preference to greenhouse products because of their fine quality. The best results were obtained with the double-film row covers. The dead air space between the two films provided sufficient insulation for tender crops to survive short frosts down to 20° F.; hardier plants survived short frosts of 0° F.

Tests also showed that proper ventilation under the row covers was highly important. Cutting slits in the film about 15 in. long every few feet is recommended by the Experiment Station. Too big a vent leads to wind damage, too little ventilation produces excessive heat build-up under the plastic. Notches bent in both sides of the wire wicket will hold the vent open. During hot weather the vent is opened wide by setting both sides of the film slit back under its notch. On frosty nights the vent is closed up.

Using a slight variation of the row-cover idea, tomato growers in San Diego County, Calif., are employing polyethylene films to protect their late-ripening pole crops. More than 100 acres of poled tomatoes were wrapped in polyethylene film during Septem-

ber and October, 1955. After three to four months under the film cover, preliminary tests indicated that the tomatoes had shown superior resistance to Botrytis fungi. In addition, the polyethylene film proved to be simpler to install than previously used shade materials.

Pigmented and perforated

The California tomato growers tried out a new type of pigmented and perforated polyethylene film. A combination of non-fading metal pigments was used that reflects large portions of the sun's heat radiation (red and infrared), but allows a large percentage of the growth stimulating rays (violets, blue violets, blues, and greens) to penetrate. To keep down moisture condensation inside the tomato plant cover, ventilating or aerating holes are provided. These are punched in the film about 1½ in. apart except in strips 12 in. wide in the middle and 6 in. wide at either edge. This special tomato cover film (0.0015 in. thick) is made available in rolls of 500 lineal ft., and in 4- and 6-ft. widths. This gage film is expected to last through two seasons. In Southern California, film that was both pigmented and perforated seemed to work best. For other areas where the climate differs, the film may be either unpigmented or without aerating holes. This variability to meet a wide range of conditions is one of the characteristics of the plastic films which have made them highly adaptable to many farm uses.

Water conservation

It has been estimated that anywhere from ½ to ⅓ of the water available for irrigation purposes is lost when it seeps away into the soil at the bottom of irrigation canals and watering ponds. Lining the beds of the canals and ponds with an impervious material can save considerable amounts of water needed for plant growth and stock watering. Concrete basins and channels are too costly for most farmers. Asphaltic membranes have been tried as liners but in test installations they were able to reduce seepage by only 35 to 75 percent;

polyethylene film, 0.006 in. thick, on the other hand, showed a 96% reduction in seepage in the same tests.

When properly compounded, both vinyl and polyethylene films have been found suitable for lining irrigation canals and watering ponds. These films also resist sunlight when properly prepared and are inert to soil organisms. In Texas, it has been estimated that soils with a seepage rate of about 2 cu. ft./sq. ft./day could produce additional income of from 22 cents to $1.10 per lineal ft. if the seepage could be prevented and the water made available for plant growth.

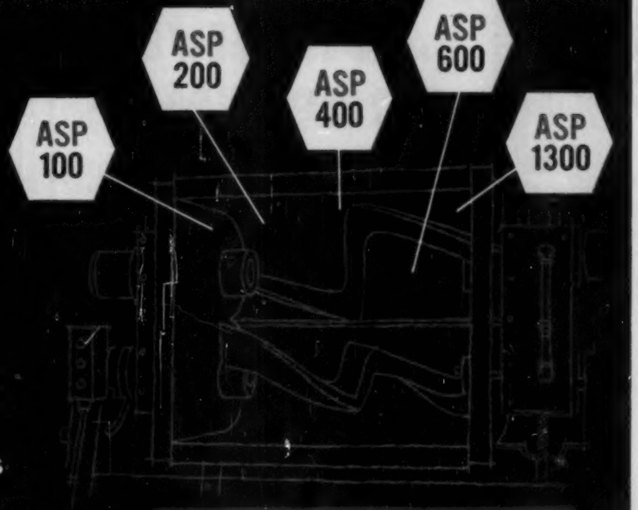
Although plastic films do not approach the durability of concrete, it is believed that the annual cost of film for linings is more favorable. The ease and low cost of installing the plastic film as well as the ability to change the course of irrigation ditches at will with the film, also make it more attractive. Except for minor mechanical damage, such as that occasioned by animals, films 0.0015 to 0.002 in. thick are expected to perform satisfactorily for at least one season.

Farm pond liners

Ponds of all sizes and shapes are found in the thousands in every farm state where they are used for stock watering and irrigation. In many of these areas a rate of seepage of only a few inches of water per month can often be critical in the operation of a farm. Water-tight linings for the bottoms of ponds can, therefore, help many a farmer from wavering in and out of debt during periodic lean years. Linings made of vinyl film may also allow the farmer to improve on nature by letting him pick the most suitable spot to locate a pond no matter what the seepage rate of soil underneath it.

In Eastern United States, Prof. A. W. Snell, head of the Agricultural Engineering Dept., Clemson College, South Carolina, has been developing the pond liner idea in cooperation with the Soil and Water Conservation Research Branch of the U. S. Dept. of Agriculture's Agricultural Research Service. A farm pond at Clemson College was lined with vinyl film that was heat-sealed to make a large tarpaulin covering about four-tenths of an acre. The liner was unrolled over bare ground to cover the bottom and sides of an excavated area. Due to seepage, the water level fell about three inches a day in the excavated area without a lining, according to Prof. Snell's measurements. With the lining in place the water maintained a fairly constant level throughout the winter. No splitting or cracking of the film was observed during this period. This saving in water in the half-acre pond would in a week's time, it is estimated, be enough to put an inch of water on more than eight acres of crop land.

At Utah State College further experiments with pond liners have shown the advisability of backfilling a few inches of soil over the liner to prevent mechanical damage to the film from animals and objects thrown into



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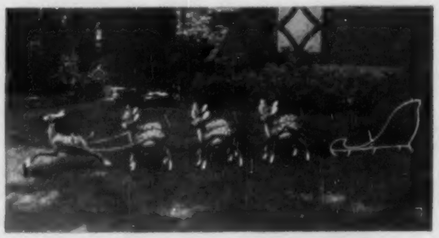
Money-Savers—ASPs will give you a whole new concept of filler economy. One of them is best for producing optimum values for the specific properties you're after. Use the coupon . . . we'll work out the details together.

In this meal tray for a leading airline, ASP filler (in high loading) helps produce a "luxury-feel," impervious surface with a long life of good looks despite the washing, sterilizing and handling of airlines service. Manufacturer reports great molding ease. (Photo courtesy Firmaline Products, Inc., Midland Park, N. J.)



Compound for making these life-size ornamental reindeer contains liberal quantity of ASP. End results: life-like fidelity of detail, beauty, strength, light weight, high resistance to weathering—all at low filler cost and high handling ease. (Photo courtesy Ornamental Crafts, Inc., Fort Lee, N. J.)

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the pond. Filling the pond with water before backfilling helps to absorb the energy of heavy aggregate that might break through the film.

Silage enclosures

Not only will these versatile plastic films keep water in place for future use but, in reverse, they keep water out of where it is not wanted. Silage, for instance, tends to spoil if it is not kept in an air-tight and water-tight enclosure. The possibilities of plastic films for silage covers have been widely investigated. Most of the applications of film silage covers were made on low-cost bunker or trench silos. At the Mississippi Agricultural Experiment Station tests showed that silage underneath a plastic cover had the least amount of spoilage, settling, and fermentation of any of the various coverings tested. Prof. Milton A. Sprague of Rutgers University, New Brunswick, N. J., tried a different approach. He has formed large tubes of vinyl film in which extra supplies of winter feed are stored at convenient spots around the farm. These portable silos are now available commercially in two sizes. The larger is 27 ft. long, 55 ft. in circumference, and holds 35 tons. The plastic tube is rolled down like a stocking and spread on the ground in a ring with the bottom end of the ring drawn toward the center to make an airtight base. A strip of conventional snow fence, set up inside the ring, forms a circular wall about 4 ft. high to hold the first layer of silage. Three or four layers are built one on top of the other like a huge wedding cake, and the film sleeve is unrolled up the sides to be gathered and tied.

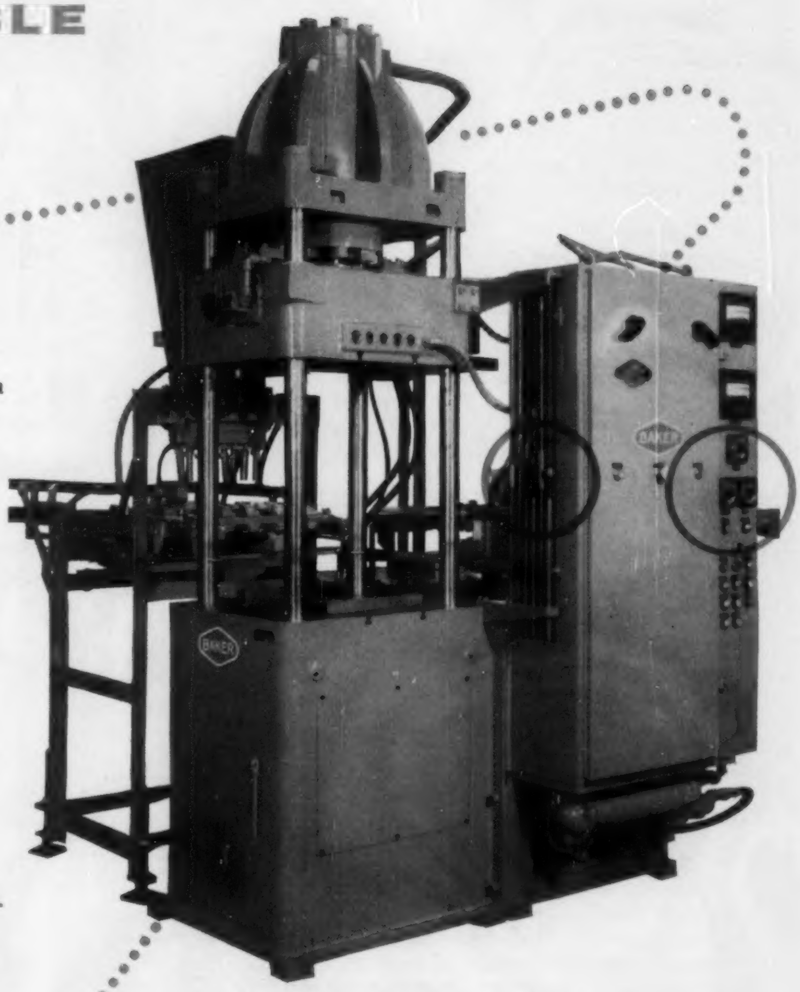
The fermenting silage slowly produces gases that inflate the airtight plastic tube. These gases are allowed to escape and the film settles back on the silage after about 96 hours. In October 1955, a farmer in Asbury Park, N. J., stored 33 tons of alfalfa mixed with corn-cob meal in one of these plastic silos. When it was opened after more than six months, it was found that all but 25 lb. of silage—no more than a good forkful—had even developed an off color.

Studies of the nutrient losses of silage have also been made. Recently it was shown that loss of digestible nutrients in a new plastic silo amounted to only 2 to 6% as compared to 20 to 50% for silage stored in covered trenches, and 10 to 15% for upright, unprotected silos. During the fermentation period of the silage the plastic film allows the passage of carbon dioxide through it, but does not allow air to come back into the silage.

Conventional, open-top silos of wood or masonry are also faced by a serious spoilage problem. For such vertical structures a silage cap made of vinyl film can bring about an important reduction in spoilage. This silage cap also maintains a high quality of palatable silage without the usual top waste. With silage valued at $10 to $12 per ton, a single silage cap could result in a $30 to $60 annual saving.—End

close . . . decelerate . . . breathe . . . open

ALL INSTANTLY ADJUSTABLE



With a Baker Plasti-Matic you can select the shortest cycle for any molding job. Close at 400″ per minute. Decelerate at any point during closing. Regulate breathe opening, dwell and cure time. Choose any break-away speed. Accelerate to 400″ per minute for remainder of open. Cure time and dwell are quickly adjusted by timers. Acceleration, deceleration and breathe opening are adjusted by setting cams. Valve settings adjust speeds. Besides that, automatic loading on Baker Presses is also quickly adjustable for different molds. Send for latest bulletin.
Baker Presses are now available with Westinghouse CYPAC controls.

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Fluorocarbon coatings

(*From pp.* 127–149)

availability of standard dispersions and primers in small aerosol bombs.

Economic aspects

Fluorocarbon protective coatings systems are not an inexpensive answer to the many service problems for which they are suited. However, they have frequently been found to be the *only* answer to extremes of thermal, chemical, electrical, and adhesion problems encountered in military and industrial applications.

Unlike most organic and inorganic coatings, plating, and other forms of protection, a coating of the recommended thickness of fluorocarbon will outlast the substrate. Such substrates may be the best "corrosion-resistant" alloys. For some service conditions, no other material exists which can provide reasonable service life. For example, plate coils, used to heat hydrofluoric acid baths, previously fabricated of a corrosion-resistant alloy, lasted from several weeks to several months. Carbon steel substitutes, coated with 10 mils of Kel-F, have been in service several years without a sign of breakdown.

On a square-foot basis, material costs involved (actual resin on a square foot area) are approximately 40¢ to \$2.00 for TFE and TFCE respectively. Substrate preparation, spraying, drying, and fusion cycles for each individual coat add a significant labor charge. Then there is capital investment in high-temperature, instrument-controlled and profiled ovens, and oven time for long baking cycles. The final cost for fluorocarbon coating will be approximately \$1/(mil, sq. ft.), or \$6 to \$10/sq. ft. for coatings 10 mils thick, the higher figure being for TFCE. This compares with an application cost of approximately \$4.50/sq. ft. for polyvinyl chloride sheet, \$3.25 for phenolics, \$2.50 to \$3.25 for chromated plastisols, and \$1.35 for sprayed vinyl coatings.

More specifically, a carbon-steel trailer tank (Fig. 1, p. 127) for transporting corrosive chemicals, when coated inside with 10

mils of TFCE resin, would compare in cost with an equivalent tank fabricated of stainless steel or stainless-clad carbon steel. Although the first cost of coating with fluorocarbon is comparable with that of a stainless tank, over-all "life" costs have been considerably lower. The fluorocarbon-coated steel lasts longer than the stainless steel.

Application cost comparisons are appreciably lower for coatings for less severe service conditions, such as thermal applications where a maximum of 0.7 to 1 mil thickness is needed, anti-hesion applications requiring 0.7 to 6 mils, and electrical insulating requirements which call for 3 to 10 mils.

Future developments

Homogeneous mixtures of TFE and a variety of other corrosion and heat-resistant materials are being evaluated. Included are rubber latices and epoxies. At present, the procedure is simply a matter of mixing aqueous-suspended materials into the standard TFE dispersion. Immiscible liquid systems are blended through the use of mutually miscible solvents such as acetone or alcohol. One important obstacle to immediate widespread use is the tendency of Teflon particles to coagulate when such blends are formulated without careful regard to pH. The effects of electrolytes, of particle size of added ingredients, and of other factors are being studied.

Development of new Teflon resins, enamels, and paints stem from such new materials as poly-FEP (tetrafluoroethylenehexafluoropropylene "copolymers") are under immediate consideration (11). An entirely new series of coating formulations as well as coating techniques could well evolve from these new resins.

In TFCE technology, Kel-F research has evolved a series of coating primers based on epoxy-type corrosion and thermally resistant copolymeric resins. Present use of improved primers of this type has already resulted in tremendous improvement in the adhesion of Kel-F dispersion coatings to metal substrates.

In addition, TFCE-modified fluoro- and chloro-vinylidene substitution products show promise of becoming a new family of lacquers and paints that do not need the present high fusion temperatures. The new formulations, based on fluorocarbons in suitable solvents, will be either air-dried or cured at 200° F. The air-dried coatings seem to have good chemical resistance, with some loss of toughness, while the heat-cured films have all the attributes of TFCE but solvent resistance.

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10. Private communication, Mar. 7, 1956, The M. W. Kellogg Co., Jersey City, N. J.
11. Private communication, May 2, 1956, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

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VACUUM COATERS. Loose leaf catalog describes principles and applications of vacuum process for low cost metallizing and decorating. Company's line includes coaters for large or small scale production. Also, specifications, price lists. National Research Corporation. **(I-601)**

HEATING CYLINDERS FOR INJECTION MACHINES. 32-page booklet describes company's extra capacity heating cylinders. Design to increase ratings on out-dated injection machines. Discusses construction, operation, installation, and maintenance. Injection Molders Supply Company. **(I-602)**

EXTRUSION COMPOUND FORMULATIONS. Technical bulletin describes eight formulations of PVC-50, a polyvinyl chloride polymer. Includes extrusion compounds for clear and opaque garden hose, shoe welting, and medical tubing. Chart includes physical properties. Diamond Alkali Company. **(I-603)**

CONTRACT MOLDING. Folder describes two-plant facilities and itemizes capital equipment of large Ohio compression, transfer, and injection molding organization. General Industries Company. **(I-604)**

"LIQUID STEEL" FOR MOLDS. Brochure describes "Devcon"—an 80% steel and 20% plastic combination. Suitable for molds, dies, repair work. Can be formed into shape without heat or pressure and hardens to a steel-like substance. Available as putty or liquid. Chemical Development Corporation. **(I-605)**

WOODEN ROLLING EQUIPMENT. Illustrated folder describes line of wooden shells, rolls, and winding core suitable for a wide variety of processing operations. Cylinder Manufacturing Company. **(I-606)**

SURFACE PYROMETERS. Folder describes extensive line of surface pyrometers with a range of from 0-1200° F. Suitable for molds, calender rolls, plastic materials. The Pyrometer Instrument Company. **(I-607)**

HIGH INTENSITY INFRARED LAMPS. Folder describes company's new line of quartz lamp oven sections for high temperature—short cycle applications. Includes diagrams of specifications and installation possibilities. The Fostoria Pressed Steel Corporation. **(I-608)**

SILK SCREEN PRESSES FOR SHEET PLASTICS. Illustrated literature describes the features, dimensions, specifications, and capacities of line of screen process printing presses. General Research & Supply Company. **(I-609)**

HYDRAULIC PRESSES. Folder illustrates line of compression, transfer, laminating and angle presses. Some models can exert pressures up to 10,000 tons. Karlton Machinery Corporation. **(I-610)**

ELECTRIC STEAM GENERATOR. Folder describes line of generators for heating molds on injection presses, extruder barrels, and embossing machines. Includes specifications, prices. Automatic Steam Products Corporation. **(I-611)**

FLUORESCENT PIGMENTS. Folder of fluorescent pigments and molding powders in company's line. Contains sample color chips. Luminous Resins, Inc. **(I-612)**

MIXERS. 12-page illustrated catalog describes company's line of intensive mixers, suitable for plastics. Includes cutaway illustrations of working parts, along with specifications and diagrams. Stewart Bolling & Co., Inc. **(I-613)**

ELECTRIC MOTORS. Illustrated brochure describes company's line of "V-S Drive" motors, designed for a wide range of industrial uses. Discusses speed ranges and speed shifts. Gives specifications. Describes various control features. Reliance Electric and Engineering Co. **(I-614)**

X-RAY FILM GAUGE. Folder describes X-ray gauge for continuous measuring of both thickness and weight of plastic film and sheeting. Said to be accurate to .00005 thickness and 1% of weight. Industrial Gauges Corporation. **(I-615)**

ELECTROFORMED MOLDS. Bulletin describes how to prepare electroformed molds for vacuum forming of plastics. Also discusses application and special features of these molds. T. V. Jay Company. **(I-616)**

VINYL EXTRUSION COMPOUND. 12-page brochure describes "Vygen 1101" company's new unplasticized polyvinyl chloride compound, for extruding operations. Tabulates physical and chemical properties; gives advantages, limitations, processing data. The General Tire & Rubber Company. **(I-617)**

DIES AND MACHINES FOR TRIMMING. Brochure describes dies and machines for cutting, perforating, flash trimming, and electronic sealing. Includes flash trim equipment for vacuum formed plastics. Western Supplies Company. **(I-618)**

WOOD FLOUR FILLER. Folder describes characteristics and uses of wood flour, as a filler in plastics compounds; includes chart of physical and chemical properties, available weights and grades. Wilner Wood Products Company. **(I-619)**

SMALL INJECTION PRESS. 26-page brochure describes line of small (one ounce or under) vertical presses for injection molding. Models are available with air or hydraulic systems. Specifications, price schedules included. Newbury Industries, Inc. **(I-620)**

ADHESIVES FOR VINYLS. Bulletin lists line of special purpose adhesives for binding flexible and rigid vinyl to themselves, to each other, and to other surfaces. Wilross Products Co. **(I-621)**

ELECTRONIC METAL DETECTOR. Illustrated folder describes electronic equipment for detecting any kind of metal or alloy, minute as well as large pieces. Includes chart specifications. Radio Corporation of America. **(I-622)**

TRANSPARENT SHEETING. Bulletin describes "Seilon DP," available in flat or corrugated rigid transparent sheets up to ⅛" thick for use as windows, partitions, and display. Lists stock sizes available, gives physical and chemical properties. Seiberling Rubber Co. **(I-623)**

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ADHESIVE AND COATING MATERIALS. Technical bulletin gives data about a series of polyvinyl acetate emulsions displaying excellent adhesion to a wide range of base materials. Lists specifications and characteristics, discusses special advantages of each item in the series. Polyvinyl Chemicals, Inc. **(I-624)**

PLASTICS MATERIALS CATALOG. 48-page illustrated brochure lists this large German chemical company's extensive line of thermosetting and thermoplastic materials. Includes such data as physical and chemical characteristics, available colors. Gives suggested applications. Dynamit-Actien-Gesellschaft. **(I-625)**

HIGH SPEED DISSOLVER. Illustrated 4-page folder describes unit for dispersion of pigments, fillers, and extenders in liquid resins, plastisols and organisols. Diagrams illustrate working action. Cowles Dissolver Co. **(I-626)**

STEEL FOR MOLDS. Bulletin gives properties and application data on "Speed Alloy," an easy-to-machine steel with characteristics that bridge the gap between the carbon and tool steels. Jones & Laughlin. **(I-627)**

DRY COLORING OF THERMOPLASTICS. Brochure reviews coloring characteristics of common thermoplastics. Describes company's line of coloring equipment, and its colorants for mottles, phosphorescents and fluorescents. Prices included. Plastic Molders Supply Company, Inc. **(I-628)**

POLYESTER RESIN FACT FILE. Folder describes company's line of polyester resins, giving physical and chemical characteristics, processing methods, applications. American Alkyd Industries. **(I-629)**

WIPING MATERIAL. Illustrated folder describes "Kimwipe," an industrial wiping material suitable for cleaning sensitive plastic finishes without marring surface. Samples are included. Kimberly Clark Corp. **(I-630)**

ROTARY KNIFE SCRAP GRANULATOR. Illustrated folder describes operation and illustrates construction features of rotary scrap granulator with models of capacities of 1 to 400 pounds per hour. American Pulverizer Co. **(I-631)**

ADHESIVES FOR FILMS. 18-page handbook discusses types, characteristics, applications, and methods of handling commercially available adhesives suitable for use on transparent film. Includes wall-size film selector chart. National Adhesives. **(I-632)**

COLOR CONCENTRATES. Catalog sheet describes granular polyethylene coloring pigments compatible with polyethylene and vinyl. Includes list of shades with their color composition and specific gravity. Harwick Standard Chemical Co. **(I-633)**

WATER CIRCULATING PUMPS. Bulletin describes equipment for cooling and circulating. Has pump with ⅓ hp motor with circulating capacity of 22.5 gallons per minute. Includes specifications, diagram of parts, prices. Sterling, Inc. **(I-634)**

CONTINUOUS WEB PRINTING. Data sheet describes rotary flexographic press which prints trade marks, names, numbers, designs upon flexible or rigid materials .001 to 1.0 inch thick and up to 74 inches wide. Includes diagram of equipment, specifications. Adolph Gottscho, Inc. **(I-635)**

INFRARED DRYING FOR LAMINATING. Illustrated report describes use of infrared oven for drying and curing resin impregnated cloth or paper prior to laminating. Edwin L. Wiegand. **(I-636)**

PHOTOELECTRIC WEB POSITION CONTROL. Illustrated 12-page booklet describes how to install and operate edge position control equipment suitable for every web guiding situation. Company's line includes medium and heavy units for handling 2,000 to 10,000 pounds and extra-heavy duty unit for exerting a thrust of about 30,000 pounds. Askania Regulator Co. **(I-637)**

PLASTICIZER MANUAL. 74-page illustrated manual describes the extensive "Flexol" line of plasticizers for vinyls, lacquers, and synthetic rubbers. Includes plasticizer selector chart, conversion tables, and suggested test methods. Carbide & Carbon Chemicals Co. **(I-638)**

POLYESTER RESINS. Looseleaf catalog describes "Laminac" line of thermosetting polyester resins. Includes recommended methods of use, compounding data, properties, and curing characteristics. American Cyanamid Co. **(I-639)**

WET BLAST FINISHING. 16-page brochure describes wet blast process for finishing molds and dies. A micro-abrasive is suspended in a water-chemical emulsion and directed against work through a nozzle. Includes illustrative material for company's line of equipment. American Wheelabrator Corp. **(I-640)**

DECORATIVE PLASTIC SHEET SAMPLES. Sample booklet includes 28-color display of acetate and butyrate sheeting for vacuum forming. Available in transparent, chalk, iridescent, and metallic colors in either smooth or embossed finishes. Gomar Manufacturing Co. **(I-641)**

VACUUM METALLIZING. Catalog describes method of applying metal coatings to plastic. Includes illustrations and specifications for company's line of vacuum metallizing equipment. High Vacuum Equipment Corp. **(I-642)**

STYRENE AND VINYL RESINS. Illustrated booklet describes uses and typical properties of "Plio-Tuf" company's new group of high styrene resins, and ranges of uses of the "Pliovic" group of vinyl chloride resins. Goodyear Tire & Rubber Company. **(I-643)**

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Plastisol viscosity

(*From pp. 159-174*)

and W. D. Todd, Modern Plastics *33*, 140 (Nov. 1955).

5. Cf. also J. R. Darby and P. R. Graham, Modern Plastics *32*, 148 (June 1955).
6. S. Zweig, Modern Plastics *33*, 123 (Sept. 1955).
7. Gel-Time Meter Cat. No. 9125531G1, General Electric Co., Schenectady, New York. Castor Gelometer, CE-50, Burrell Corp., Pittsburgh, Pa.
8. Plasticizer Catalog, Ohio Apex Div., Food Machinery and Chemical Corp., Nitro, West Va.
9. Castor Engineering Co., Carnegie, Pa.
10. Akron Pressform Mold Co., Cuyahoga Falls, Ohio.
11. Technical Service Bulletin No. 2A, Sept. 15, 1955, Du Pont.
12. M. F. Fuller, Minneapolis A.C.S. Meeting, September 1955.

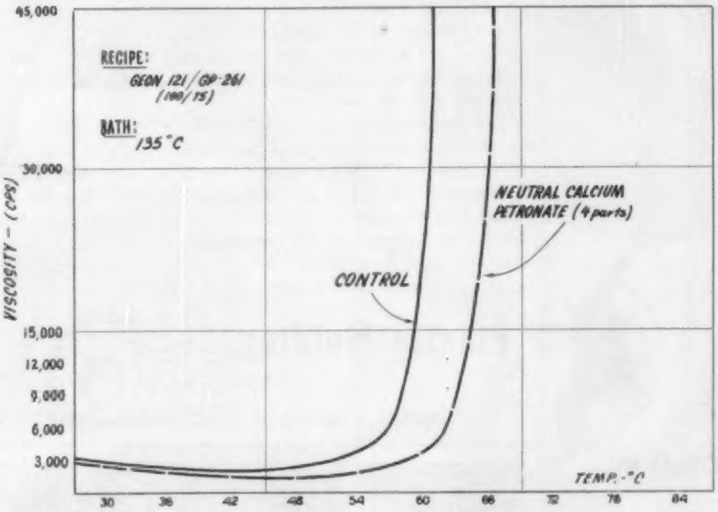


Fig. 25: Effect of additive for open-cell sponge applications

Table IV: Dip-coating chart

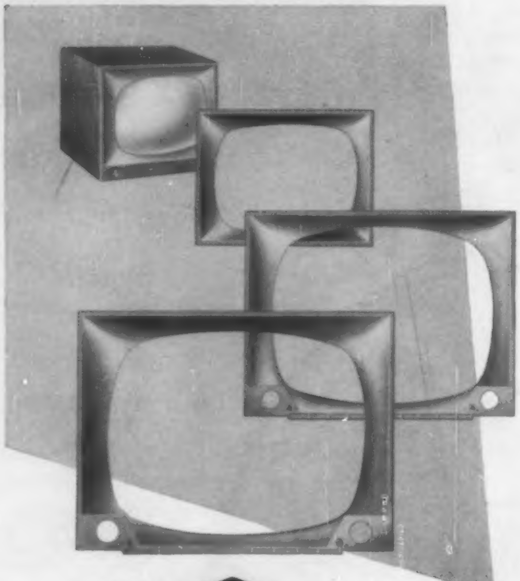
MOLD - ½" ALUMINUM ROD W/ROUND END.
DIPCOATER - FISHER PAYNE MODEL
PLASTISOL-95°F., FORMULATIONS 100/15, IMMERSION TIME-15 SEC.

WITHDRAWAL RATE ▸	2"/MINUTE			3"/MINUTE			4"/MINUTE		
PREHEAT TEMP. ▸	200°F.	300°F.	350°F.	200°F.	300°F.	350°F.	200°F.	300°F.	350°F.
#1. GP-261	12	74 (52)	89 (15)	26	67 (41)	75 (8)	24	59 (35)	54 (15)
#2. GP-261 SM-20 100 d/cm²	38	97 (59)	108 (11)	40	80 (40)	95 (15)	36	70 (34)	62 (-8)
#3. GP-261 SM-30 200 d/cm²	44	96 (52)	87 (-9)	33	88 (55)	96 (8)	34	71 (37)	59 (-12)
#4. GP-233 10 d/cm²	25	67 (42)	85 (18)	19	48 (29)	71 (23)	19	28 (9)	71 (43)
#5. GP-233 SM-25 75 d/cm²	45	80 (35)	112 (32)	40	72 (32)	92 (20)	33	68 (35)	87 (19)
#6. GP-233 SM-35 160 d/cm²	56	92 (36)	115 (23)	56	92 (36)	107 (15)	50	81 (31)	93 (12)

SM - SUPERMULTIFEX USED WITH ADDITIONAL PLASTICIZER (DA - 15) FOR BUILDING YIELD. THE INDICATED YIELD WAS OBTAINED.

KEY: 00(a) with boxed 00(b) — (a) THE COATING THICKNESS (IN MILS); (b) THE DIFFERENCE IN COATING THICKNESS (IN MILS), OVER PRECEDING PREHEAT TEMPERATURE PICK UP

In television . . .



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Lacquers

frame the best pictures

The lacquer finish on the polystyrene "mask" or frame (shown above) surrounding the picture tube is vital to good TV viewing. Glare and reflection must be reduced to a minimum and colors must blend attractively with the television cabinet.

Here is how NELCO Lacquers serve one major television manufacturer:

The Problem
To lacquer finish black polystyrene "masks", attractively, economically.

The Answer
Production-line, hand-spraying with one coat of flat, fast drying NELCO Polystyrene Lacquer.

The Results
Handsome, no-glare, non-reflective finish.
Scratch and blush resistant.
Excellent adhesion.
Reduction of costs. No-glare lacquer replaces expensive etching of metal molds.

NELCO lacquer formulations are available in all metallic shades for every coating requirement—cellulose acetate, vinyl, acrylic, cellulose acetate butyrate and rubber. Write for complete information on these lacquers and, for our recommendations, just outline your problem to us.

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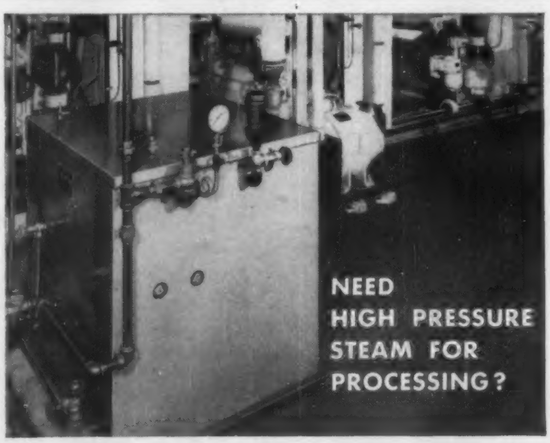

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The Plastiscope

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 45)*

Styrofoam for houses

Styrofoam frequently used as insulation material for freezer and cooler spaces and other low temperature applications, is now being widely promoted in the residential field as perimeter insulation and as a combination and plaster-base material in masonry homes.

The result is a home that is easy to heat in winter and keep cool in summer. Styrofoam insulation also eliminates the clammy coldness generally associated with such structures in colder areas and provides dry, comfortable living conditions. In order to tell this story to the public, The Dow Chemical Co., Midland, Mich., producer of Styrofoam, is circulating a motion picture.

Dow produces the lightweight foam by expanding polystyrene approximately 40 times. As early as 1946 several masonry homes were constructed in Midland to determine if the material was suitable as a plaster base. The result was favorable. Boards of Styrofoam are easily applied to the inside of bare exterior masonry walls by means of low cost Portland cement mortar. Two coats of plaster then can be applied directly over the Styrofoam. This method of construction completely eliminates the use of furring strips and rock lath or plaster board, reducing installation time and labor considerably. In addition to concrete construction, Styrofoam can be used with SCR large-size brick or brickrete that does not require studding and as the inner layer in brick cavity wall construction, although in the latter case interior walls would of course require furring before plastering.

*Reg. U.S. Pat. Off.

As perimeter insulation, Styrofoam is laid in either horizontal or vertical positions. When horizontally installed, the material is merely placed on fill around the perimeter of the home and the concrete slab poured over it. Styrofoam boards, in the vertical application method, are usually placed dry on the inside of the foundation and the backfill shoveled against them.

Spaghetti tubing

Teflon electrical spaghetti sleeving insulation combining good electrical and mechanical properties is being offered by Shamban Engineering Co., 11617 W. Jefferson Blvd., Culver City, Calif.

Designated Kelon-T, the material is unaffected by a wide range of ambient temperatures. Applications include sheathing for hook-up wire insulation for solder junctions and terminals in electronic components. Non-electrical applications include instrument and medical tubing.

> Because of important recent developments, Part 2 of our series on Thermoset Reinforced Molding Compounds which was scheduled for this issue will appear in the October issue. This article will deal with the reinforced phenolics, melamines, and silicones.

Arc-resistant laminate

Paper-base laminate with reported superior arc and flame resistance is available in production quantities from National Vulcanized Fibre Co., Wilmington, Del. Called Phenolite Y-2500, it is bonded with a modified phenolic resin that gives fire-resistant qualities. Its general properties correspond to NEMA Grade XX; in addition, it has an arc resistance up to 100 seconds. The new material is claimed to shave better than paper-base laminates presently used for arc-resistant applications. As a self-extinguishing laminate, it passes the standard Underwriters' Laboratory flame test.

Phenolite Y-2500 is recommended for such applications as arc deflectors, circuit-breaker components, electrical switches, and other interrupting devices. It is available in sheet sizes of 39 by 47 in. and 39 by 39 in., and in thicknesses ranging from 0.015 to 1 inch.

Koppers to furnish know-how

Contracts for the engineering design and operating know-how of a polystyrene plant have been awarded Koppers International, C.A., by Huiles, Goudrons et Derives, of Paris, France. Under the terms of the agreement, Koppers will provide all the engineering plans for the plant, including specifications, detailed flow sheets of the operating process, and general plant layout.

In addition, Koppers will provide the French company with operating know-how necessary for the manufacture of polystyrene under processes used at Koppers' Kobuta, Pa., plant.

Silicone emulsions down

Prices for HSC 35, 515, and 362 silicone emulsions have been reduced approximately 4¢ a lb. in all container sizes by Harwick Standard Chemical Co., 60 S. Seiberling St., Akron, Ohio.

Printing inks available

Production of a complete line of inks for printing on Mylar polyester film has been announced by Claremont Pigment Dispersion Corp., 32 Powerhouse Rd., Roslyn Heights, N.Y. Formulations for gravure printing, flexographic printing, silk screening, stamping, and striping can be supplied from stock. Formulations for special applications are available to order. These "MY" series inks can be handled on conventional

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equipment. Only conventional thinners are required.

Claremont also announces the availability of the "VC" series, solvent-based inks for vinyl valley printing (inlay printing). Advantages claimed for the VC series include: extremely high flash point; inks do not attack rubber rolls; inks do not dry on embossing roll during operation; inks clean themselves from embossing roll after a stoppage of any duration; inks are stable in the fountain—evaporation of solvent will not cause inks to coagulate; all colors, including metallics, display good storage stability; and bright, sharp opaque prints have good adhesion.

Bonding tape

Composed of hundreds of parallel fibrous glass yarns uniformly coated and impregnated with polyester resin, Varband bonding tape, developed by Varflex Corp., Rome, N. Y., finds application in armature banding, core and stator winding, and coil tying supports; it can also be used for anchoring wires in vibrating power tools, or wire assemblies that rotate at high speeds. The tape may be wound around wires as with ordinary tape and the end can be heat-sealed by a soldering iron, eliminating knots. The material lends itself to knotting and tying where desired.

When cured, Varband bonding tape becomes a homogeneous, machinable mass. Recommended curing time is 3 hr. at 125° C. or less at high temperature.

Currently, the tape is available in six standard widths, ranging from 10 to 120 ends, with a thickness of 0.015 to 0.030 inch; special orders may be obtained upon request.

"True-porosity" exchanger

By using a radically new process in making ion-exchange resins, Chemical Process Co., Redwood City, Calif., has developed a product which is claimed to be superior to presently available exchangers.

Ion-exchange resins are used in various purification applications. They function by removing undesirable ions from a solution and replacing them with ions attached to solid insoluble materials. For example, ion exchangers find application in water softening by removing calcium and magnesium ions. Exchangers also find numerous uses in industrial applications, such as concentration reactions (recovering valuable material from a dilute concentration), separation reactions (recovery from metal-treating wastes), and lately in the decontamination of radioactivated water.

One of the most important properties of an ion-exchange resin is what is termed its porosity; that is, the amount of space in the resin molecule matrix. It is this intermolecular space that permits the diffusion of molecules through them and the actual process of ion exchange.

In the traditional method of making ion exchange resins (copolymerizing styrene with a polyvinyl cross-linking agent such as divinylbenzene, then chloro-methylating and aminating), porosity is varied by varying the amount of DVB cross-linking agent in the initial copolymerization. The first resins were produced with 8% DVB. However, it was found that these products resisted the diffusion of large molecules into their interstices and these exchangers at times lost capacity due to an irreversible adsorption of such molecules in the pores. A reduction of DVB in the original copolymer to 3 to 4% resulted in a product with a higher degree of apparent porosity but at the same time in a weakening of the resin matrix, making these products more subject to physical degradation.

Chemical Process Co., in its Duolite A-100 series, does not use divinylbenzene as a cross-linking agent but uses a cross-linking method (not available for publication) which results in a resin structure in which there are actual micropores and channels distributed through a solid gel matrix. This the firm terms true porosity. Because of this true porosity, the company feels, Duolite 100-A exchangers will handle jobs that others cannot, such as in applications where the irreversible adsorption of large organic molecules is a necessity. In surface waters containing appreciable amounts of organic matter, use of conventional anion exchangers has led to rapid decline in capacity because of "organic fouling." Duolite A-100 series exchangers are expected to be less subject to this shortcoming.

Resins available in this series are A-101 and 102 (strongly basic) and A-114 (weak base).

Vinyl-clad IBM's

All of International Business Machines Corp.'s electronic data processing machines, and most of its standard line of electric accounting equipment, will soon be turned out in Armorhide, a textured vinyl spray finish reported to improve the durability and appearance of machine covers.

The finish was developed as the result of a cooperative development project of IBM's engineering departments and John L. Armitage Co., Newark. N. J. It was found to hold up four times better against abrasion and to be twice as resistant to scratching as wrinkle-paint finishes. IBM also expects that the use of Armorhide will eliminate much of the repainting and retouching of covers that are damaged during assembly and shipment.

Adhesive line expanded

Production of resin-base, multipurpose adhesives, designated Tygobond 40, 41, and 45, has been announced by U. S. Stoneware Co.'s Adhesives Div., Akron, Ohio. Developed primarily to bond vinyl foam and sponge to themselves or to vinyl fabrics, metal, wood, or composition bases, these air-drying, fast-tack type adhesives are crystal clear and

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non-staining. Tygobond 40 is formulated for spray applications; Tygobond 41 and 45 are easily applied by brush or machine coating. The adhesives require only contact pressure, without heat curing, to produce a clear bond that is resistant to water, acids, alkalies, oils, and certain solvents.

The company also announces that its line of thermosetting adhesives, based on alloyed epoxy resins, is now being produced in the form of paste, mat, powder, rod, liquid, and gel.

In paste form, Tygoweld is a two-component system employing an amine activator. All other forms of Tygoweld are one-component systems.

Plastics grow in Puerto Rico

The twenty-seventh plastics product installation established in Puerto Rico by U. S. mainland companies under "Operation Bootstrap" since 1950 is Fluorocarbons of Puerto Rico, an affiliate of Bonney Mfg. Co., Auburnville, Mass. The company produces Teflon tape for use by the Armed Forces.

Laminates offered

Three standard grades of polyester resin-glass mat laminates—GP-9100, GP-9104, and GP-9202—are now available from National Vulcanized Fibre Co., Wilmington, Del.

GP-9100 is a general-purpose, medium-cost sheet with good electrical and mechanical properites; GP-9104 is a low-cost grade with lower mechanical properties than GP-9100; it possesses fair electrical properties; and GP-9202 is a flame-resistant grade; also best electrical grade, except for arc resistance.

Plastics pass fire test

Fibrous glass-reinforced Hetron polyester panels, designated Fire-Snuf, have been approved by Factory Mutual, insurer of industrial buildings, for use in industrial construction. Approval was granted following a series of large-scale tests that showed that these panels, produced by Resolite Corp., Zelienople, Pa., would in no way contribute to flame spread throughout an industrial plant in the event of fire.

This structural plastic panel, chiefly used in wall daylighting and skylighting of buildings, now carries both the Factory Mutual seal and the label of Underwriters' Laboratories. When using this material, no additional insurance is required when there is no sprinkler system, provided other non-combustible materials are used in conjuction with Fire-Snuf. Fire-Snuf obtained the UL Label in September 1955 which tests for fire hazard to occupants, while Factory Mutual tests for physical damage.

Polyethylene film

Transparent untreated polyethylene tubing, which is non-blocking and has slip for easy opening, is being offered by Food Film, Inc., Clinton Rd., Caldwell Township, N. J. Called Food Film TS, the material sells at regular film prices and is available in layflat sizes of 2, 2¼, 2½, 2⅝, 3, 3¼, 3½, 3¾, 4, and 4½ inches.

Plastics course, fall term

Registration for the fall term at the Special Courses Div., Newark (N.J.) College of Engineering, will take place August 27 to 31 and Sept. 4 to 7, 1956. Plastics courses include Process Properties of Plastics, Extrusion of Plastics, and Advanced Plastics Process Techniques.

Strippable coating

Plastic emulsion, called Strip-Kote, for protecting smooth and wrinkled metal, enameled, and lacquer finishes; highly machined precision parts; plastic; glass; and chrome-plated surfaces from being marred or scratched during processing, shipment, and storage has been developed by Chemical Consulting Service, 3711 S. Clement Ave., Milwaukee, Wis.

The coating, a milky-colored, latex-type emulsion, is a water-base type of material. The water evaporates from the emulsion to leave a tough, flexible, water-resistant film. It is applied by brush or spray gun. The dried film is permanently flexible and easily stripped.

New molder

Formation of M.C.I. Plastics Corp., Greenville-Ramtown Rd., Howell Township, N. J., has been announced. The new firm, equipped with injection molding machines ranging from 4 to 16 oz., will specialize in the production of plastics packaging components. Richard Hartung is president.

Anti-oxidant

Manufacture of an anti-oxidant, under license from Gulf Oil Corp., for use in plastics, rubber, and other products, has been started by Catalin Corp. of America, 1 Park Ave., New York, N. Y.

The product, an alkylated cresol, is offered in two grades—technical and food—designated AC-1 and AC-3, respectively. In the plastics field, the material provides protection from embrittlement and discoloration due to oxidation in vinyl, polystyrene, and polyethylene products.

VFD-9033 okayed for 75° C.

Additional listing by Underwriters' Laboratories, Inc. for Bakelite general-purpose polyvinyl chloride electrical insulating compound VFD-9033 as conforming with UL requirements covering 75° C. thermoplastic insulated electric blanket wire has been announced. The compound has previously received listing as 60° C. type T and TW, where exposed to oil at 60° C.; and 80° C. appliance and hook-up wire insulation.

Vulcanized fibre now in consumer ad program

Household items of vulcanized fibre continue to get widespread promotion by National Vulcanized Fibre Co., Inc., Wilmington, Del., which was the first company to develop this old-time indus-

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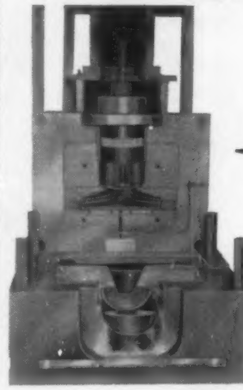

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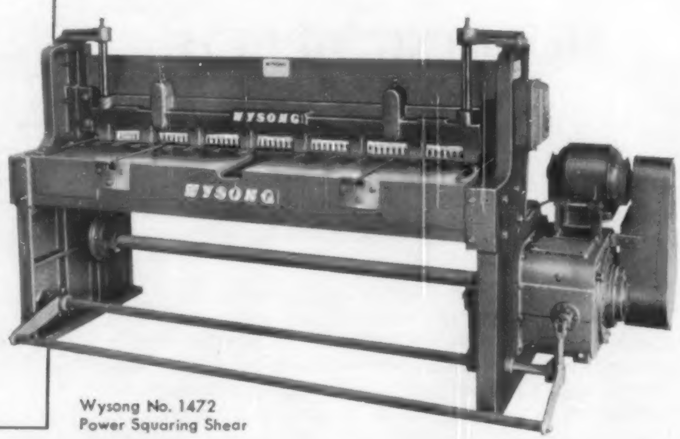

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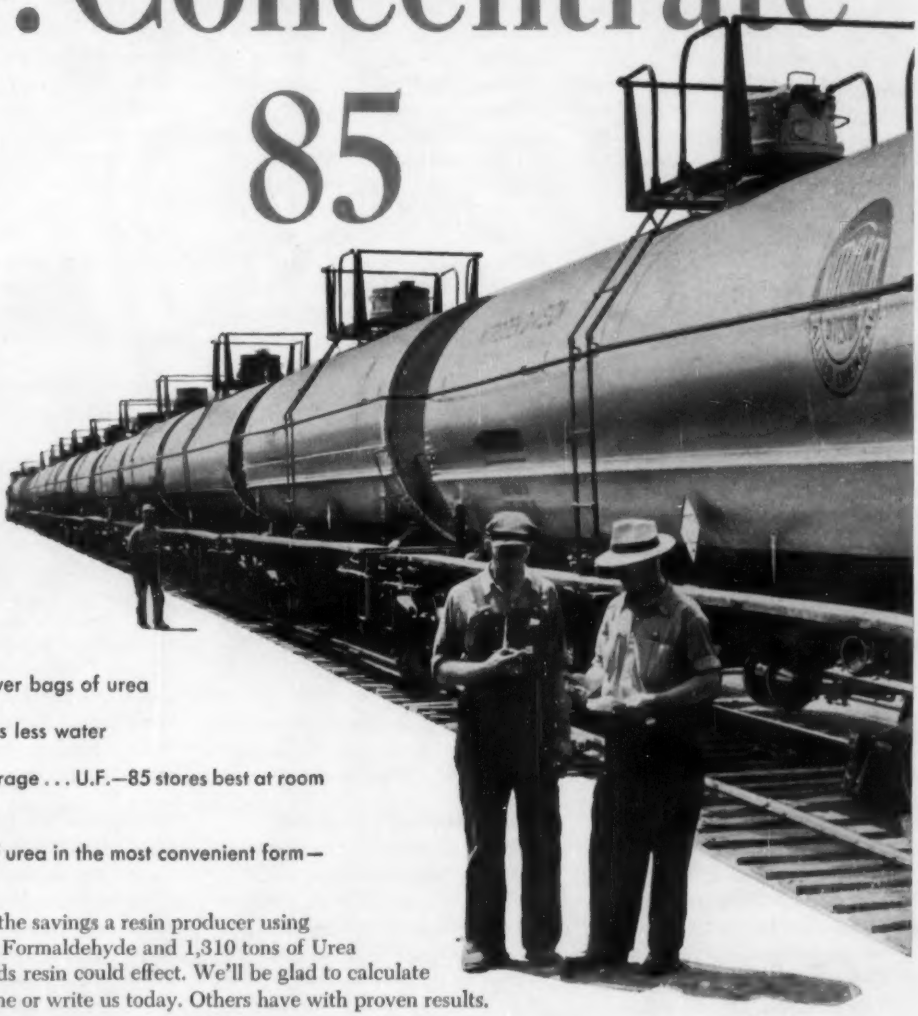

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trial plastic into a successful material for consumer applications.

An extensive campaign for the new Vulcot hampers and waste baskets, the line spearheading the firm's consumer program, will include large space in various consumer magazines.

Hampers and waste baskets are the first consumer products to be made of vulcanized fibre. (See MODERN PLASTICS 33, 196, June 1956.) National is planning additional product lines; a second group of vulcanized fibre houseware items will be ready for the market in the near future.

Universal spray finish

Introduction of a universal finish, reported to work well on all polystyrenes and polystyrene copolymers, butyrate, phenolics, polyesters, and other materials, has been announced by Logo, Inc., 12933 S. Stony Island Ave., Chicago, Ill.

Designated Logo R-200, the universal finish is designed to obviate the need for a different type finish for each general group of plastics.

Industrial adhesives

A new line of industrial adhesives, comprising both thermosetting and thermoplastic types of adhesive compounds, has been introduced by Raybestos-Manhattan, Inc., Bridgeport, Conn., and will be marketed under the tradename Ray-Bond.

Materials with which Ray-Bond adhesives can be used effectively for bonding, coating, or sealing include wood, metal, plastics, glass, ceramics, friction material compounds, leather, paper, insulation materials, rubber, and cork. The only type of adhesive produced by Raybestos in the past was for bonding friction materials (break linings, etc.).

New gasketing material

High-pressure sheet stock laminate consisting of plies of mechanically interlocked synthetic fiber felt impregnated with Teflon resin has been developed by American Felt Co., Glenville, Conn., for use as a gasketing material. The significance of the development lies in the fact that the exceptional thermal and chemical properties of Teflon are now available in a gasketing material with low cold-flow characteristics. Designated Teflon-Vistex, the material combines a controlled ratio of felted fibers to impregnant and the product is defined as a fiber-reinforced polymeric mass.

The company manufactures Teflon-Vistex gaskets in two types: Type W is a tough, high-tensile-strength material for general-purpose applications; Type NS is a moldable material especially suited for applications involving irregular flange surfaces and pressures. Both types lend themselves to fabrication as precision-cut gaskets, strips, and washers. The materials are presently available in thicknesses from 1/64 to 1/16 inch.

Some of the properties of Teflon-Vistex are: thermal stability up to 420° F.; stability toward virtually all chemicals; good gasket seating action despite surface imperfection as great as the thickness of the gasket itself; tensile strength up to 5000 lb./sq. in.; and ability to seal with a minimum pressure on either polished or irregular surface.

Export package program

Plastics machinery manufacturers and some processors are using an audio-visual package program to develop European markets for their products. The program is produced in the United States, effectively translated overseas by a multi-lingual staff, and then shown to prospective European customers.

The presentation consists of a documentary film depicting the client's industry and a motion picture, sound-slide film, or projector slides of the client's plant. The visual medium gives the viewer the feeling of actually witnessing production of the client's equipment, product, or process.

Overseas preprogram planning includes scheduling for showings at leading hotels in various European cities, advance publicity in local newspapers and other chosen media, and direct invitations to executives and distributors.

The service is being offered by International Researchers Associated, Div. of International Processes, Inc., 624 S. Michigan Ave., Chicago 5, Ill.

New container line

Nested polystyrene and high-impact polystyrene containers for packaging ice cream, sherbet, cottage cheese, salads, candies, and various other products have been developed by the Millsplastic Div. of Continental Can Co., 2930 N. Ashland Ave., Chicago, Ill.

The containers, made in 8-, 12-, and 16-oz. sizes, using one lid size for all, are designed for hand or automatic filling and capping.

Nopco Lockfoam for potting

A gas-expanded, foamed-in-place, cellular plastic developed by Nopco Chemical Co., Harrison, N. J., is becoming widely accepted for use in the electrical and electronic industries as a potting and encapsulating material.

Designated Lockfoam, this organic polyisocyanate material is used as a potting medium for delicate electronic instruments and as a barrier against deterioration of electric wire connections, resistors, condensers, electron tubes, etc.

Adhesives for plastics

Two new plastic adhesives—145-0 Styrogrip and 3570 Polygriptex—have been developed by Adhesive Products Corp., 1660 Boone Ave., New York 60, N. Y. 145-0 Styrogrip, a quick-drying resin solvent adhesive is for use in bonding polystyrene foam to plywood, galvanized iron, concrete block, and other surfaces. 3570 Polygriptex, with a flexible plastic base, makes it possible to bond polyethylene to chip and kraft board in the manufacture of packaging envelopes and poly-

ethylene-laminated bags and boxes.

Another adhesive development, 292 Polyseam, has been announced by Anchor Adhesives Corp., 36-23 164th St., Flushing, N. Y. The product is a "universal" foam adhesive, bonding rubber foam to polyurethane or vinyl foam and all three to wood, Masonite, steel, aluminum, etc. According to the company, seams made with this adhesive do not harden with age.

New foam fabricator

Formation of American Plastics, Inc., Clayton, Ohio, as a fabricator of cut Styrofoam and expanded polystyrene parts has been announced. George Charleston is president and James L. Erickson vice president.

Epoxy kits for field use

The problem of correctly proportioning resin and hardener in epoxy adhesive formulations is ingeniously tackled in an epoxy adhesive kit now being produced by Houghton Laboratories, Inc., Olean, N. Y. The kit is designed for use in the field and comprises two tubes containing preweighed and preproportioned amounts of resin and hardener, respectively. When a bead of any length is squeezed from the resin tube on a mixing surface, the user then only needs to match that bead in length with the hardener bead. After thorough mixing, the adhesive is ready to use. This feature eliminates on-the-job weighing for exact proportions, precludes human errors, and assures precise mixture for best results.

Another approach to the same problem is taken by Minnesota Mining & Mfg. Co., St. Paul, Minn., which has packaged its Scotchcast electrical insulating epoxy resin No. 4 in the Unipak container. The resin is used to encapsulate electrical splices of all kinds on the construction site. The container is a plastic envelope containing premeasured epoxy resin and activator separated by a dividing membrane;

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they are mixed in the package by breaking the divider and kneading.

The company has also announced price reductions ranging from 4 to 32% for resin No. 4. Price changes on quantity orders (1000 units) include a drop of from $1.35 to $1.30 on the A size container; from $3.24 to $2.21 on the B container, and from $5.40 to $4.13 on the C size container.

Adhesives for packaging

Formulated for use in skin and blister packaging, adhesive coatings designated Torriseals, have been introduced by Pierce & Stevens Chemical Corp., Buffalo, N. Y. The coatings are applied to the paperboard to which plastics formed skins or blisters are bonded. Torriseal E-1303, a modified cellulose ester composition, is used for cellulosic skins or blisters; Torriseal C-9047, based on vinyl copolymer resins, is used for vinyl materials.

Applied to the boxboard by roller or spray application, the coating forms the seal between the blister or skin and the boxboard when re-activated by heat.

Jobs for chemists

The Southern Research Laboratory of the Dept. of Agriculture is expanding its research program to improve the quality of cotton fiber, yarns, fabrics, and textiles and to produce products with greater utility in such fields as surface coatings, plasticizers, printing inks, and many other industrial fields. Research is also being done on pine gum, turpentine, and rosin.

Chemists with specialization in the fields of analytical, organic, physical, inorganic, and biochemistry are invited to apply for these positions and similar positions with other federal agencies in Texas, Oklahoma, Louisiana, and Arkansas by submitting an application form (SF-57) to the Director, 8th U. S. Civil Service Regional Office, 1114 Commerce St., Dallas, Texas. Application forms may be obtained at most post offices.

Salaries range from $5440 to $10,320 per annum, depending upon the level of responsibility assigned.

Urethane processor

A new user for urethane foam is American Latex Products Corp., 3341 W. El Segundo Blvd., Hawthorne, Calif. The company is producing a lightweight polyurethane material, called Stafoam, for use as non-slip or insulating padding or backing for throw rugs, carpeting, table mats, or coverings.

Stafoam is similar to foam rubber in appearance and is claimed to have several advantages: it can be sliced as thin as 1/16 in.; it can be sewn; it will not support combustion; it can be laundered, having a high resistance to abrasion and tearing; Stafoam is fungus-, vermin-, and insect-proof and can be cemented to almost any material; and it can be manufactured with a resilience from extra soft to rigid and with a density from fine to coarse. The foamed material can be made either waterproof or highly absorbent.

Stafoam has a thermal conductivity factor (K) of 0.19 which makes it ideal as insulating tablecloth padding for hot dishes and as ironing board covers. The material is said to retain all its characteristics even when subjected to live steam.

Wax for stiffer polyethylene

Synthetic mineral wax FT-300 can be blended with high-pressure polyethylene to increase its rigidity. The wax, distributed by Dura Commodities Corp., 20 Vesey St., New York, N. Y., is produced by the synthesis of carbon monoxide and hydrogen.

FT mineral waxes have approximately the same melting point as high-pressure polyethylene and have a high softening point. They are claimed to be in all proportions with the polyethylene and not to separate upon aging of the blend. In respect to maintaining heat resistance of the polyethylene, they are said to be superior to paraffin wax, petroleum wax, or other mineral wax types. In addition, vapor permeability is also claimed to be reduced.

S.P.I. acts on tile

A special committee on Installation Procedures has been formed by the Plastic Wall Tile Div. of the Society of the Plastics Industry, Inc. The committee is gathering installation experience from manufacturers and will shortly codify all of them in one standard installation instruction booklet which is expected to help assure perfect installations.

The committee is headed by J. L. Sampson of Wilson Plastics, Inc.

Premeasured epoxy

To make it more convenient to use resins for plastic tooling and other production purposes, premeasured amounts of resin and hardener in its line of liquid epoxy compounds are now being offered by Marblette Corp., 37-31 Thirtieth St., Long Island City, N. Y.

Compounds offered in premeasured packages include resins #604A, a laminating thixotropic gel coat with fast cure, and #607, a laminating resin capable of creating a strong bond that will not delaminate. Both of these are low-irritant resins.

Ink for polyethylene film

A new "RP" ink system for gravure printing on treated polyethylene now offers all the performance properties which printers normally expect of conventional gravure inks, according to an announcement by Claremont Pigment Dispersion Corp., 39 Powerhouse Rd., Roslyn Heights, N. Y. Available in a full color range, including metallics, these storage, stable, concentrated inks are said to provide the printer with the flexibility necessary to adjust inks for printing with engravings of any depth and pattern.

Other advantages claimed for

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the RP series are: inks can be thinned with standard thinners; all colors can be intermixed; no changes in printing procedures are necessary; four-color printing possible at high speeds; excellent lay-down of inks on film; relatively static-free operation; no alteration required in forced-drying equipment; bright, intensely colored prints with sharp definition; prints with good block resistance (no blocking exhibited in tests at 120° F. under 2½ lb./sq. in. pressure for 24 hr.); prints have excellent scratch- and abrasion-resistance; and easy clean up of equipment.

Informative labeling contest

A second informative labeling contest, sponsored by the Public Relations Committee of The Society of the Plastics Industry, Inc., was announced at the opening of the Housewares Exhibits. The contest is open to companies and individuals (members and non-members of S.P.I.) who manufacture or market plastic products at the retail level. It is part of the plastics industry's program to increase retailers' and consumers' knowledge of plastics and how to take care of them.

Manufacturers and marketing firms are invited to submit informative labels, accompanied by the products they identify, to S.P.I. headquarters, 250 Park Ave., New York, N. Y. The contest closes December 1. Winners will be announced early in January 1957 during the Chicago market weeks for housewares and furnishings.

Improved fibrous glass

A 50% increase in modulus of elasticity of fibrous glass was achieved (in recent research for the Air Force) by the continuous formation of fibers of a calcium aluminate glass in a small textile glass bushing. High modulus fibrous glasses are required by the Air Force primarily for reinforced plastic materials.

Resistance of these glasses to chemical attack by water and water vapor is much less than that of commercially produced textile fibrous glass. The glasses are resistant to hydrofluoric acid but are completely soluble in hydrochloric acid. Their dielectric constants are higher than that of present textile glass, and the loss tangents are about the same.

An exploratory study of glass-plastic combinations from the calcium aluminate glass was also initiated in the research. Volan A was found to be the best coupling agent tested for this glass.

The complete report of this research, PB 111789 "The Development of Fibrous Glasses Having High Elastic Moduli," G. R. Machlan, Owens-Corning Fiberglas Corp., for Wright Air Development Center, Nov. 1955, may be ordered from OTS, U. S. Dept. of Commerce, Washington 25, D. C. It contains 112 pages and costs $3.00.

Synthetic reinforcement

Felt-like structures produced by mechanically interlocking synthetic fibers are now being offered by American Felt Co., Glenville, Conn. The industrial fabrics, having the physical characteristics of wool felt and the thermal and chemical properties of synthetic fibers, are expected to find use as reinforcements for plastic lamination and other applications.

According to the company, the felts have increased resin capillary absorption because of fine denier single-fiber construction; greatly reduced surface fiber migration due to a three-dimensional fiber tie-in; high abrasion resistance; high-impact strength; low moisture absorption; and low electrical conduction properties, wet and dry.

Teflon felt

Designed for use in severe physical and chemical environments where other gasket materials fail, Teflon-impregnated Teflon felt can be used in the production of resilient gaskets and gasket materials (Teflon itself is non-resilient).

The impregnated felt, designated S-16810 and supplied by Shamban Engineering Co., Culver City, Calif., is available in thicknesses of 1/16, ⅛, and ¼ in., with special orders on request.

Heat-reflective laminate

Designed for aeronautical applications, a heat-resistant laminate said to afford a very efficient barrier to heat transfer at temperatures up to 1200° F. has been developed by Swedlow Plastics Co., 6986 Bandini Blvd., Los Angeles, Calif. Weight savings and adaptability to molded designs are claimed to be additional advantages of this material.

The laminate is composed of glass fabric, high-temperature-resistant silicone resin binders, combinations of highly reflective metallized surfaces, and inert substances for added resistance to surface corrosion. The material has found applications in the North American Aviation's Super-Sabre Jet F-100 and other aeronautical products.

Wrinkle plastisol

A plastisol that cures to a wrinkle pattern has been introduced by The Stanley Chemical Co., a subsidiary of The Stanley Works, East Berlin, Conn. The coating, a 100% solids material, is slightly reduced with a thinner and applied over a primer by spraying.

The fused coating is said to have good hardness, perspiration resistance, and good general chemical resistance. Its abrasion resistance is claimed to be superior to regular wrinkle enamels.

New phenolic

Availabilty of a new heat-resistant, medium-impact phenolic has been announced by the Durite Dept. of The Borden Co.'s Chemical Div., 350 Madison Ave., New York, N. Y. Called HR-322, the new material, which can be compression and plunger molded and preformed, is currently finding greatest use in utensil handles, automatic skillet thermostat housings, and similar applications.

According to the company, HR-

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322 has withstood 425 to 450° F. for 24 hr. without ill effects; its Izod impact strength is 0.4 ft.-lb./in. of notch. The material sells in the general-purpose price range, and is at present available only in black.

Epoxide for use at 600° F.

An epoxide casting resin, Stycast 2662, which can be used at temperatures as high as 600° F., is now being offered by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. The resin pours readily and cures at low temperature and, according to the manufacturer, maintains high volume resistivity at elevated temperature, making it suitable as a potting and encapsulating compound.

Stycast 2662 is claimed to have low shrinkage during cure, excellent adhesion, and a low thermal expansion coefficient.

Removable coating

Designated I-Sis 88, a strippable, modified vinyl coating has been developed by I-Sis Chemicals, Inc., Springdale, Conn., for coating copper and silver hollowware and flatware to protect them against tarnishing during packaging, shipping, and handling. The clear coating can be readily removed by the housewife.

Plasticizer news

Low-temperature plasticizer. Plasticizer SC, a triglycol ester of a vegetable oil fatty acid which imparts low-temperature properties to polyvinyl chloride compositions and nitrile rubber, has been developed by Harwick Standard Chemical Co., 60 S. Seiberling St., Akron 5, Ohio. It is also said to be of considerable value in neoprene compounding.

Plasticizer SC is practically odorless and is soluble in most solvents.

In addition to being compatible with nitrile rubber, neoprene, and polyvinyl chloride and its copolymers, SC is claimed to be compatible with polyvinyl butyral, polystyrene, coumarone resins, ethyl cellulose, and nitrocellulose.

Harwick cuts price. New prices for Harwick Standard Chemical Co.'s Polycizers 332 (dioctyl adipate), 532 (octyl decyl adipate), and 632 (didecyl adipate) are: tankcar and tanktruck, 40¢ a lb.; truckload and carload, 42¢ a lb.; less than truckload drums, 43¢ a lb.; and 5-gal. cans, 54½¢ a pound.

New polymeric plasticizer. Primary, polymeric plasticizer NP-10 for PVC compounding has been introduced by Eastman Chemical Products, Inc., Kingsport, Tenn., a subsidiary of Eastman Kodak Co. The plasticizer, based on neopentyl glycol, combines permanence properties, ease of processing, low-temperature flexibility, and low color.

Low-cost plasticizer. Brown-Allen Chemicals, Inc., Staten Island, N. Y., is offering a new, low-cost plasticizer for use in vinyl formulations. Called Polycon 5B, the plasticizer replaces higher-priced n-O-nDP where low temperature and low volatility are desirable. Typical uses are for sheeting, coated fabrics, and film.

In plastisol formulations, Polycon 5B is claimed to offer good flow-out properties, slow gellation, and fast cure. It is said to be especially suitable for slush molding operations.

U. S. Dept. of Agriculture offers patent. A basic patent, U. S. Patent No. 2,745,749, on the preparation of the chemically-modified fats known as acetoglycerides is available for licensing without cost. The patent is on a process developed at the Southern Utilization Research Branch of the Agricultural Research Service, USDA. Acetoglycerides have shown possibilities as plasticizers and lubricants.

Expansion

Borden Co.'s Chemical Div., Polyco-Monomer Dept., has opened a new polymerization plant at Demopolis, Ala., with an initial annual production of 10 million lb. of polyvinyl acetate. The company claims that the new facility will be the first such operation in the Deep South, where the growth of the paper, textile, adhesives, and paint industries has been outstanding. All have polyvinyl acetate applications.

The Chemical Div. has been operating in the Alabama town since 1950, manufacturing urea resins and formaldehyde. **Robert Stickney** is superintendent.

Westmoreland Plastics Co., Inc., Latrobe, Pa., custom molder of plastics and manufacturer of plastics hardware for domestic cooking ranges, has purchased certain patents, tools, and manufacturing facilities of **Lloyd Products Co.**, Providence, R. I.

The Lloyd lines of fluorescent lampholders and starter sockets will henceforth be produced by the recently formed Lloyd Div. of Westmoreland Plastics at the Latrobe plant. Addition of the Lloyd items to its product line will enable Westmoreland to offer appliance manufacturers a more complete assortment of appliance hardware.

Pacific Plastic Products, San Francisco, Calif., injection molder, has added 14,000 sq. ft. of space to its factory, bringing the total size of all facilities to 32,000 sq. feet.

Cast Optics Corp., Hackensack, N. J., is stepping up production of its optically clear cast acrylic sheets to 70,000 lb. a month in all sheet sizes and thicknesses. These include the first grade and lower-priced S grade categories. The sheet is used for glazing, instrument windows, signs, displays, boat windshields, etc.

Additional equipment has been added in anticipation of further

(To page 272)

The Plastiscope

production expansion. Sheet sizes currently available range up to and including 48 by 72 in. in thicknesses from 0.030 to 0.500 inch.

Narmco Metlbond Co., Costa Mesa, Calif., announces expanded facilities for the pilot-plant production of Multiwave, a flexible sandwich core material produced continuously on completely automatic fabricating equipment. The Multiwave equipment is adaptable to the continuous production of aircraft core materials from reinforced plastics, paper, and other materials.

Tri-Point Mfg. & Developing Co. has added 5000 sq. ft. of manufacturing and office space to its existing plant at 401 Grand St., Brooklyn, N. Y. The firm specializes in fabricating electronic insulation, chemical, and other parts from Teflon, nylon, Kel-F, Rexolite, various laminates, and other materials. Tri-Point also production-extrudes Teflon rod.

Pennsylvania Color & Chemical Co. has approved plans for enlarging its plant at Doylestown, Pa. New facilities will make possible an increase of about 20% in output. Some of this will be in the form of increased manufacturing capacity for pigment dispersions in vinyl resins and also for a broad line of transparents for foil and metal coatings. The new unit is planned to go on stream during the first quarter of 1957.

Canadian Industries Ltd. announces a further addition to its research and development laboratory facilities. The new laboratory will be located on the site of C-I-L's Fabrikoid works at New Toronto, Ont., and will service the company's Plastics and Fabrikoid Divs.

The plastics section will replace the plastics laboratory at C-I-L York works in Toronto, and will be equipped with modern, commercial-sized extrusion, injection molding, paper coating, and wire covering machines. Its chief function will be to provide increased technical service to Canadian plastics converters, many of whom are located in the Toronto area. The new laboratory will operate in conjunction with the company's plastics development laboratory at Edmonton and research laboratory at McMasterville, Que.

Monsanto Chemical Co.'s Plastics Div., Springfield, Mass., has tripled its capacity to produce vinyl chloride paste resin with the installation of new equipment.

Monsanto's vinyl stir-in paste resin, Opalon 410, may be compounded into plastisols for fabric coating, slush molding, dipping, film casting, and production of vinyl foams.

Gomar Mfg. Co., manufacturer of metallized plastic sheeting and laminates, has moved from 79 Paris St., Newark, N. J., into its new plant at 1501 Blancke St., Linden, N. J. The plant is the first of four units to be constructed in the next three years on the 4½-acre site. When completed, Gomar will have a total of 100,000 sq. ft. of floor space.

Sealview Co., Wayne, Pa., will more than double its facilities by the purchase of the Reinforced Plastics Div. of **Gladwin Plastics,** Atlanta, Ga. The long-stroke presses will be moved to Wayne for immediate production of a fibrous glass laundry hamper. Sealview forms and fabricates thermoplastics and reinforced plastics.

William Brand & Co., Inc., Willimantic, Conn., announces the construction of a 33,000-sq. ft. addition to its North Windham plant. The extension will include an enlarged section for the production of laboratory-formulated plastics used in Turbo wires and cables; it will also include space for a newly established high-temperature materials division.

Meetings

Plastics groups

October 11-12: The Society of the Plastics Industry, Inc., New England Section Conference, The Wentworth Hotel, Portsmouth, N. H.

December 4-5: The Society of the Plastics Industry, Inc., Seventh S.P.I. Film, Sheeting and Coated Fabrics Division Conference, Commodore Hotel, New York, N. Y.

Other meetings

September 9-12: American Institute of Chemical Engineers, Meeting, William Penn Hotel, Pittsburgh, Pa.

October 1-3: National Electronics Conference, Hotel Sherman, Chicago, Ill.

October 22-25: Society of Industrial Packaging and Materials Handling Engineers, Annual Protective Packaging and Materials Handling Exposition and Conference, Kiel Auditorium, St. Louis, Mo.

October 22-26: National Industrial Exposition and Management Conferences, Detroit Artillery Armory, Detroit, Mich.

October 31-November 2: Society for Experimental Stress Analysis, Annual Meeting and Exhibit, Deshler-Hilton Hotel, Columbus, Ohio.

November 6-8: Packaging Association of Canada, Fifth Canadian National Packaging Exposition, Automotive Building, Canadian National Exhibition Grounds, Toronto, Ont.

November 22-December 3: Society of Industrial Chemistry, Assembly of Chemical Arts, includcluding special Session on Plastics Materials and Rubber, 28 rue Saint-Dominique, Paris 7, France.

November 27 - 30: American Chemical Society, Ninth National Chemical Exposition, Cleveland Public Auditorium, Cleveland, Ohio.

Company Notes

Reichhold Chemicals, Inc.: Dr. Fred A. Jolles, member of the board of directors, named vice president in charge of the Foreign Div.; **Herbert R. Helbig**, vice president of the Export Dept.; **Sam Gurley, Jr.**, vice president in charge of sales development; and **George C. Sweet**, vice president in charge of purchases. **Don Leever** back after three years to become division director of technical services in St. Louis, St. Paul, Kansas City, Denver, Houston, and Dallas.

Minnesota Mining & Mfg. Co.: Alexander L. Donaldson now technical service manager of the Reinforced Plastics Div.; **John J. Jungbauer** division engineer for reinforced plastics; **Joseph F. Morrisette** sales supervisor for reinforced plastics for the West Coast.

Plastic Artisans, Inc., designer and manufacturer of custom and standard packaging in transparent and opaque formed plastics, has moved from 70 Westchester Ave., White Plains, N. Y., to its new plant at Dock St. and Martin Place, Port Chester, N. Y.

Celanese Corp. of America: Charles M. Reynolds, formerly assistant director of sales for film, named sales director of the Plastics Div.'s newly established Sheet Dept. Molding compounds, along with the polyolefin resins which Celanese will market under the name of Fortiflex, will remain under the sales direction of **Richard M. Leiter**, who headed the formerly combined Sheet and Molding Compounds Dept. **Charles H. Edgar**, formerly New England sales representative, succeeds Mr. Reynolds as assistant director of sales for film.

Sinko Mfg. & Tool Co., plastic molder and fabricator, has moved from 3135 W. Grand Ave., Chicago, Ill., to its new plant at 7310 W. Wilson Ave., Chicago. The new building comprises an area of 60,000 sq. ft. and houses machinery for molding all thermoplastics, including nylon, in capacities up to 100 ounces.

Morart Gravure Corp., Holyoke, Mass., has acquired **Oxford Corp.**, Dayton, Ohio, which will operate as a wholly-owned subsidiary under the name of Morart-Oxford Corp. Oxford makes etched copper cylinders, reproductions of wood-grains, marbles, fabrics, and other materials. **Charles F. Moriarty** is president.

Automatic Molding Machine Co., Los Angeles, Calif., manufacturer of Automold high-speed, fully automatic compression molding machines, has named **Robert W. Brandt** of Plastic Molders Engineering Co., Chicago, Ill., and **Don Boschert** of Dunning & Boschert Press Co., Syracuse, N. Y., as its representatives.

Hooker Electrochemical Co.: John K. Gallagher promoted to district sales manager for California; **Neil M. Barber** to Philadelphia district sales manager; **H. McIntosh Beatty, Jr.** to technical service representative at Tacoma, Wash.

Durez Div.: Lewis J. Pentland, Evan E. Graham, and **Henry B. Puff** promoted to district sales managers for New York, California, and Chicago, respectively.

Plax Corp.: Three members of the Research, Development and Engineering Dept. have been promoted: **Grant S. Brown** promoted from assistant manager of research to manager. New assistant research managers are **Robert G. Strauss**, responsible for blownware engineering, and **Richard J. Morcom**, in charge of extrusion engineering. **S. F. Schillaci** named assistant to the president; in addition, he will continue as production manager.

Bakelite Co.: J. R. Akers named manager of the Flexible Packaging Materials Div., responsible

Company Notes

for the sale of plastic materials used in the manufacture of flexible packaging for consumer and industrial packaging.

Koppers Co., Inc.: A Plastics Applications Section has been established in the Chemical Div., with **W. J. Fitzgerald** as manager. **D. H. Blair** appointed plastics applications representative for Western New York, Pennsylvania, Ohio, Eastern Michigan, and Kentucky; **V. O. Reising** for the Midwest; and **Lacy Seabrook** for the Eastern Seaboard states.

American Cyanamid Co., Plastics and Resins Div.: **Albert J. Kirsch,** with the company since 1945, appointed technical service representative for coating resins; **William G. Simons,** with the firm since 1943, named technical service representative for adhesive, laminating, and reinforced plastics resins.

Harwick Standard Chemical Co., Trenton, N. J., appointed sales agent by **Arnold, Hoffman & Co., Inc.** for Nonox WSP, an anti-oxidant for polyethylene and rubber; Nonox WSL, an anti-oxidant for rubber and latex; and Vulcacel BN, a blowing agent for manufacturing cellular rubber.

Improved Machinery, Inc.: Winthrop A. Fleming and **Robert S. Ward** appointed sales engineers; **Sidney O. Arnold** named service representative.

General Aniline & Film Corp.: A long-range planning section has been added to the Commercial Development Dept. of the Dyestuff and Chemical Div. under the supervision of **Dr. Albert Bloom** who has been named manager of planning.

Cadillac Plastic & Chemical Co.: Milwaukee branch opened at 517 N. Broadway. Two more branches in the Midwest are scheduled to be opened shortly, making a total of eight warehouse-sales office units. Other branches are in Chicago, St. Louis, Los Angeles, and

Company Notes

San Francisco. The company is a warehouse distributor of thermoplastic sheets, rods, and tubes and producer of cast acrylic and cast styrene rods, tubes, and massive sheets.

Molded Fiber Glass Co. and **Molded Fiber Glass Sheet Co.,** Ashtabula, Ohio, have opened an eastern sales office at 429 Howe Ave., Passaic, N. J., to be managed by **Frank Kelsey,** former New York sales representative for both firms.

The Stanley Chemical Co.; Valentine B. Chamberlain, Jr. appointed assistant sales manager in charge of national accounts; **Robert F. McTague,** assistant technical director; **Donald M. Bell,** laboratory consultant; and **Arthur B. Vincent,** chief chemist.

New England Laminates Co., Inc. has acquired the facilities of **Rowland-Laminates** (formerly Plastilight, Inc.), 481 Canal St., Stamford, Conn. Nelco, laminators of plastics for the electrical and electronics industries, makes Epoglas, epoxy-glass cloth laminate.

Auburn Button Works, Inc.: John H. Woodruff, formerly vice president, elected president, succeeding **E. Brewster Crawford,** resigned; **Merton R. Turrell** named a vice president; **Lester R. Lessig,** elected secretary and a director of the company.

Bagphane Corp., 65 S. 11th St., Brooklyn, N. Y., converter and printer of packaging materials, has created a new Point of Purchase Div. which will manufacture transparent acetate signs, vacuum formed molded displays, and other advertising specialties. **Marvin A. Kirk** is merchandising manager of the division.

The Dow Chemical Co.: Eastern Research Laboratory at Framingham, Mass., established, with **Dr. Fred W. McLafferty** as director. The laboratory will be responsible for fundamental research on a long-range basis, including the areas of organic and inorganic chemicals and plastics, and will also carry on analysis and testing work.

J. H. Pearce, with the company since 1948, promoted to manager of Styrofoam sales, replacing **Robert L. Curtis** who has resigned.

L. G. Maclise appointed supervisor of plastic sales in the San Francisco office.

The New Orleans, La., sales office, formerly at 925 Common St. is now located at 305 Maritime Bldg.

The General Tire & Rubber Co.—Respro Div.: Lawrence D. Bragg promoted to acting general manager, succeeding **R. S. Newell,** resigned. The division manufactures plastic sheeting for use in the handbag, footwear, novelty, and upholstery fields.

Textileather Div.: Richard Nutt to assistant district manager for the West Coast, with headquarters in Los Angeles; **John R. Lange** succeeds Mr. Nutt as product manager in charge of sales to furniture and allied manufacturers: **John L. Howald** named product manager handling sales to luggage, leather goods, and shoe manufacturers.

Eastman Chemical Products, Inc.: Joseph L. Reynolds transferred to the Chicago office as sales representative for Tenite plastics, replacing **William P. Gideon,** now representative in charge of a new Plastics Div. sales office established in Kansas City, Mo. **Floyd Patrick** to Chicago office as service engineer for Tenite plastics and **John McKenzie** to Dayton, Ohio, office.

Cutter Laboratories, Berkeley, Calif., pharmaceutical house, has completed negotiations to acquire all the outstanding common stock of **Geo. A. Coleman Co., Inc.,** owner of **Pacific Plastic Products,** San Francisco. Acquisition of Pacific Plastic marks Cutter's second entry in the plastics industry in less than a year, having acquired **Plastron Specialties, Inc.,** Los Angeles, in 1955. Pacific Plastic will continue to operate as a wholly-owned Cutter subsidiary,

(To page 280)

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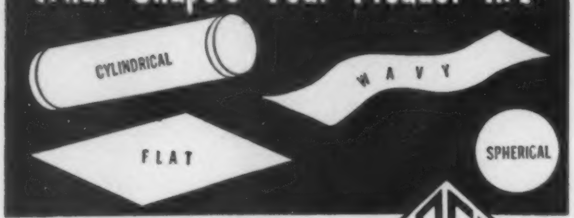

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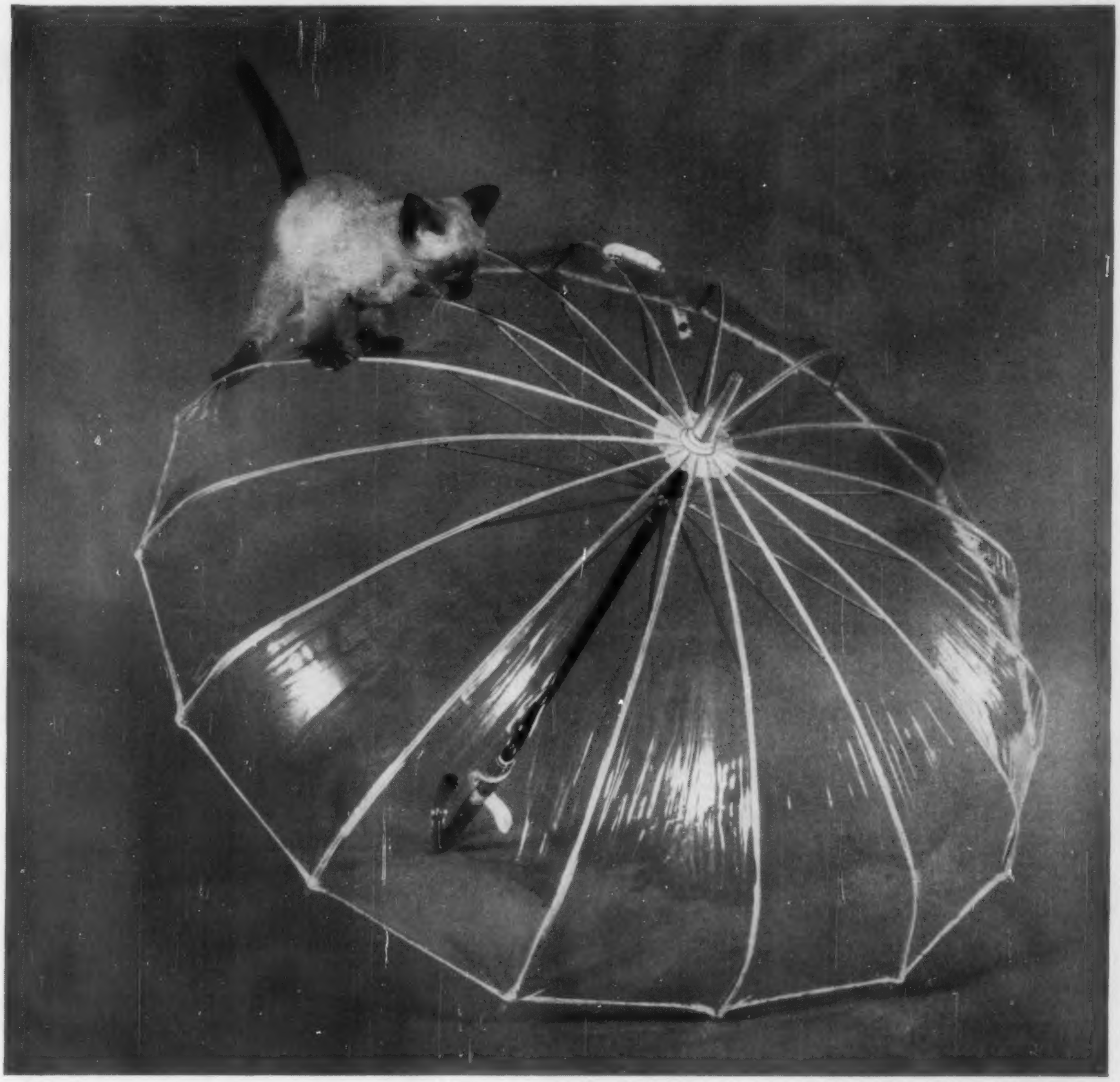

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HYDRAULIC PRESSES. Folder illustrates line of compression, transfer, laminating and angle presses. Some models can exert pressures up to 10,000 tons. Karlton Machinery Corporation. (I-610)

ADHESIVES FOR VINYLS. Bulletin lists line of special purpose adhesives for binding flexible and rigid vinyl to themselves, to each other, and to other surfaces. Wilross Products Co. (I-621)

STEEL FOR MOLDS. Bulletin gives properties and application data on "Speed Alloy," an easy-to-machine steel with characteristics that bridge the gap between the carbon and tool steels. Jones & Laughlin. (I-627)

PHOTOELECTRIC WEB POSITION CONTROL. Illustrated 12-page booklet describes how to install and operate edge position control equipment suitable for every web guiding situation. Company's line includes medium and heavy units for handling 2,000 to 10,000 pounds and extra-heavy duty unit for exerting a thrust of about 30,000 pounds. Askania Regulator Co. (I-637)

POLYESTER RESINS. Looseleaf catalog describes "Laminac" line of thermosetting polyester resins. Includes recommended methods of use, compounding data, properties, and curing characteristics. American Cyanamid Co. (I-639)

VACUUM METALLIZING. Catalog describes method of applying metal coatings to plastic. Includes illustrations and specifications for company's line of vacuum metallizing equipment. High Vacuum Equipment Corp. (I-642)

Any of the booklets described here, plus many others—forty-four in all—are available for the asking, without charge or obligation.

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Company Notes

with **Robert Greenhood** as president. **Dr. Robert K. Cutter** is president of the pharmaceutical firm.

Advance Solvents & Chemical, Div. of Carlisle Chemical Works, Inc.: Executive, general, and sales offices will be located at 500 Jersey Ave., New Brunswick, N. J.

Monsanto Chemical Co.—Organic Chemicals Div.: **Thoburn P. Sands** and **William B. Hicks** appointed section managers in the Development Dept. Mr. Sands will manage the department's petroleum chemicals and functional fluids section; Mr. Hicks will manage the plasticizers, resin materials, and paper chemicals section. **George R. Buchanan, Jr.** named associate manager of petroleum chemicals sales. **Harold F. Shattuck** now eastern technical manager. **Joe N. Butler** appointed senior sales engineer on resin materials, succeeding **August R. Hemple** now sales representative at the Cincinnati office.

Metal & Thermit Corp.: Harry W. Buchanan III named sales manager of chemicals, metals, and plating .products; **George Betz** product manager for chemicals and metals; and **Donald R. Meserve** product manager for coatings. **Bernhard W. Weber,** formerly production manager, now manager of manufacturing, succeeding **Walton S. Smith** who retired after 37 years' service. **H. Alfred Rack,** formerly manager of engineering, replaces Mr. Weber as production manager.

Tracerlab, Inc.: H. W. Bacon appointed assistant sales manager of the Industrial Div. and **William B. Fitzmaurice** New England sales representative. The division supplies automatic process control and non-destructive testing equipment.

Shell Development Co.: Dr. C. W. Smith, assistant department head of the Plastics and Resins Dept.

Company Notes

at the Emeryville, Calif., Research Center, to New York on a two-year assignment as technical assistant to **Dr. Harold Gershinowitz**, president. Dr. Smith succeeds **Dr. F. M. McMillan** who is returning to Emeryville to resume his duties as head of the Polymer and Chemical Applications Dept. **T. F. Mika**, formerly a research supervisor in the Polymer and Chemical Applications Dept., now acting assistant department head of Plastics and Resins.

Haynes Co., 1215 E. 20th St., Tulsa, Okla., has been appointed manufacturers' representative for complete line of polyethylene and polyvinyl chloride laboratory ware, self-supporting structures, and semi-finished components by **American Agile Corp.**, Maple Heights (Cleveland), Ohio.

Plastics Molders Engineering Co., 55 E. Washington St., Chicago, Ill., named sales agent in the greater Chicago-Milwaukee area for the dry colorants line and the prelubricated Colortrol for polystyrene and polyethylene produced by **Riverdale Color Co.**, Newark, N. J.

General Electric Co.: Dr. A. Eugene Schubert appointed manager of the Chemical Development Dept. at Pittsfield, Mass., devoted to applied research for the Chemical and Metallurgical Div.'s new chemical products. **Richard A. Steenrod** named a materials engineer for the Silicone Products Dept.

Heyden Chemical Corp.: W. L. Vega appointed manager of newly formed Special Products Div. of **American Plastics Corp.**, a wholly-owned subsidiary. **James P. Scullin** named chief of the vinyl applications laboratory of **Nuodex Products Co. Div.**

Aceto Chemical Co., Inc., Flushing, N. Y., has opened a West Coast office at 6850 Tujunga Ave., N. Hollywood, Calif. The company makes plasticizers, glycols, and glycol solvents.

Personal News

Willard deCamp Crater, Jr., formerly with Naugatuck Chemical Div., U. S. Rubber Co., now marketing director of **W. R. Grace & Co.'s Polymer Chemicals Div.**

A. G. Hewitt, previously general manager of the Food Casing Div., now vice president in charge of all research, engineering, industrial engineering, and market research facilities of **The Visking Corp.**

Hallberg Hanson, with the firm since 1946, named plant manager of **The Kendall Co.'s** new $1 million Polyken industrial tape plant now under construction in Franklin, Ky.

Bernard P. McGuire now head of the Micarta Div. of **United States Plywood Corp.** Micarta is a high-pressure laminate manufactured by **Westinghouse Electric Corp.** and exclusively distributed by United States Plywood.

Earl F. Harris, former executive vice president, elected president of **Rodney Hunt Machine Co.,** Orange, Mass. The firm supplies rolls and special roll-using machinery to the plastics, rubber, paper, and other industries.

Kenneth W. Ericson, former general sales manager of Titanium Pigment Corp., joined **Wittaker, Clark & Daniels, Inc.** and will be responsible for developing and promoting the sales of the company's line of colorants, especially phthalocyanines and ultramarines.

Howard T. Cusic, formerly with Owens-Corning Fiberglas Corp., named industrial sales manager of **U. S. Polymeric Chemicals, Inc.,** Stamford, Conn., manufacturer of impregnated fabrics, papers, and mats for the plastics industry.

B. J. Manno now eastern sales representative of **O'Sullivan Rubber Corp.'s Plastics Div.,** Winchester, Va. He will handle Sullvyne-Clad metal laminate, a vinyl sheeting laminated to various thicknesses of metal and thermoplastic sheeting suitable for vacuum formed products.

Morris Jalazo, formerly with Stauffer Chemical Co., now a project engineer in the Design and Estimating Section of the Engineering Dept., Chemical Divs., **Pittsburgh Coke & Chemical Co.**

Milton D. Lange, formerly with Armstrong Tire & Rubber Co., now in charge of the sales office in Monroe, La., of the Carbon Black and Pigment Div. of **Columbian Carbon Co.**

Maclean (Kanney) Brown now operations manager in charge of production and supervision of the Spare Parts Dept. of **Hull-Standard Corp.,** Abington, Pa., manufacturer of semi-automatic and fully automatic molding presses.

F. Farwell Long, previously plant manager of American Viscose Co., appointed to coördinate the distribution of in-plant plastisol systems and the installation of commercial applications at **Quelcor, Inc.,** Chester, Pa. The company makes plastisol coatings for chemical corrosion resistance.

David Packard named supervisor of Rextrude Sales, **The Rex Corp.,** maker of flexible and rigid extrusions.

Maynard Shaffer, with the firm since 1932, promoted to pricing specialist for the Closure and Plastics Div. of **Owens-Illinois Glass Co.**

Charles W. Edmondson appointed eastern district sales manager of Shakeproof Div., **Illinois Tool Works,** Chicago, Ill. Shakeproof manufactures a line of fastening devices used in the plastics and other industries.

Lorraine J. Baxter, formerly of The Borden Co.'s Chemical Div.,

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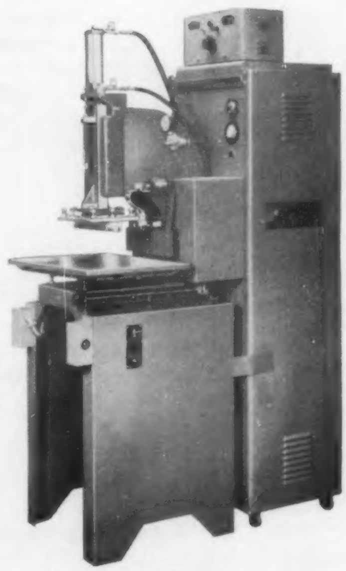

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named director of technical sales-service of **The Macco Chemical Co.**, Wickliffe, Ohio. The company manufactures resins, adhesives, and similar products.

Ed Smart, formerly sales engineer of Horace Blackman Co. and Catalin Corp. of America, named sales engineer of **Corrosion Resistant Products, Inc.**, a division of **Loven Chemical of California**.

Meyer Feinstein now on the sales staff of **Sommers Plastic Products Co.** will be in charge of the Special Effects and Two-Tone finishes produced by **Lion Products Co.**, a subsidiary of **The General Tire & Rubber Co.**, in addition to selling other plastic materials distributed and converted by Sommers.

William L. Niclaus re-elected president and chairman of the board of directors of **Wilpet Tool & Mfg. Co.**, Kearny, N. J. The company is engaged in the injection molding of plastics on a custom and proprietary basis, marketing the Wilpak line of plastic containers.

Arthur Pearce named director of customer service for **Arthur Colton Co.** The firm makes, among other products, machinery for the plastics industry.

Allan H. Stone now production manager of **Cellu-Craft Products Corp.**, New Hyde Park, N. Y. The company specializes in designing, converting, and color-printing of flexible packaging materials.

James F. Herslow appointed general sales manager of two associated firms in Maplewood, N. J.: **Sillcocks-Miller Co.**, manufacturer of plastic specialties, and **Lusteroid Container Co.**, manufacturer of a line of plastic vials and tubes.

John C. Hamilton, with the firm since 1943, promoted from general superintendent to vice president of manufacturing of **Canadian Resins and Chemicals, Ltd.**

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Used or resale only

Machinery and equipment for sale

FOR SALE: Marco Process consisting of: Homogenizer, Roto-Feed Mixers, Reactors. Kom-Bi-Nators Pumps, all stainless steel. Heavy Duty Double Arm Sigma Blade Mixers. (2) Readco 50 gal. 30 HP; (2) W & P 100 gal; (2) J. H. Day 75 gal. stainless steel. (2) Kux Rotary Pellet Presses. (3) Sprout-Waldron Horizontal Ribbon Mixers 336 cu. ft. (12,000#) capacity. (1) St. St. Pug Mill 7" diameter x 3'9" long overlapping chambers, jacketed 75#. (4) Mikro Pulverizers #2DH, #2TH, #3TH. (3) Fitzpatrick Stainless Steel Comminuting Machines. Models D. K. & F. We Buy Your Surplus Equipment. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: 3,000# Hex Mixer, two compartments—1,500# capacity each. Driven with 5 HP motor with built-in magnetic brake. Handy handler conveyor for easy loading. Excellent for mixing and blending plastic materials. Easy to clean. Best offer. Moslo Machinery Company, 2443 Prospect Avenue, Cleveland 15, Ohio.

AVAILABLE AT BARGAIN PRICES: Baker Perkins 50 gallon capacity Stainless Steel Steam Jacketed Heavy Duty Mixers with Stainless Jacketed Blades, motorized power tilting, motor driven. W & P 200 gallon Heavy Duty Mixer, tilting type, with Sigma Blades. J. H. Day from ¾ up to 100 gal., Imperial and Cincinnatus D.A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Mikro Bantam, 1SH, 1F, 2TH, 3TH Pulverizers. Gemco 2000 lbs. 56 cu. ft. Double Cone Blender. Day, Rotex, Tyler-Hum-mer, Robinson, Raymond, Gayco, Great Western Sifters. Colton 2RP and 3RP Rotary Tablet Machines. Carver Laboratory 20 ton hydraulic Press. Package Machy. FA, FA2, FA4, Miller, Hayssen, Scandia, Hudson Sharp, Oliver Auto. Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements. Union Standard Equipment Co., 318-322 Lafayette St., New York 12, N.Y.

FOR SALE: Watson Stillman 6A machine with new 8 ounce IMS cylinder. (1940). Excellent condition. Need room for larger machine. Being used for regular production. Can be seen in operation. Price . . . $1950.00 including extra cylinder and large amount of spare parts. Robinson Plastics Corp., 132 Lafayette Street, New York City, WOrth 2-7246.

FOR SALE: Hydraulic Presses: Birmingham 2400 Ton Belt Press 65"x25'6", 24-11" Rams; Hpm 1200 Ton 15 Opening 100"x 120" Steam Platens, Self contained; Baldwin Southwark 800 Ton, 10-opening, 42"x42" Steam Platens; Hpm 750 Ton, Down-Acting, 59"x44" bed, Self-contained; Morane 669 Ton, 3 Upmoving Rams, 16" stroke; Farrel 625 Ton, 52"x52" Platens, Self-Contained; Watson-Stillman 600 Ton, Hobbing, M.D. Pump; Farrel 393 Ton, 2-Opening, 48"x48" Steam Platens; Elmes 350 Ton, Down-Acting 30"x36" Bed, Self-contained; Lake Erie 300 Ton, 30"x30" Platens, Self-Contained, Semi-Automatic; Lake Erie 215 Ton, 36"x 36" Platens, Self-Contained, Semi-Automatic; Elmes 200 Ton 14" Ram x 42" Stroke 30"x24" Platen 100 HP M.D.; Carey 150 Ton, 21"x16" Platen, Adj. Dlo 8"-28" (3); Lake Erie 100 Ton, Down-Acting, 24"x24", Bed, Hi-Speed, Self-Contained; Farquhar 100 Ton, Down-Acting 30"x28" Bed, Self-Contained; Farquhar 100 Ton, Drawing, Down-Acting, 29"x34" Bed, Hi-Speed, Self-Contained Hpm 100 Ton, Fastraverse, Down-Acting, 30"x30" Bed, Self-Contained Watson-Stillman 100 Ton, Down-Acting, 22"x20" Bed, Self-Contained; Watson-Stillman 100 Ton, Burroughs 75 Ton, HPM 35 Ton Molding Presses Farquhar 75 Ton Up-Acting 30"x 42" Platens; Baldwin-Southwark 50 Ton, Angle Molding Press; Watson-Stillman 50 Ton, 12"x17" Elec. Htd. Platens; Farrel 50 Ton, 12"x12"; Loomis 40 Ton, 4 Opening 12"x12" Elec. Platens. Francis 40 Ton, 4-Opening, 12"x12" Elec. Htd. Platens; Baker 30 Ton Full Automatic, 21"x26"; Watson-Stillman and Elmes 30 Ton and 20 Ton Lab Presses; Stokes Model 200D-2, 15 Ton Automatic and Stokes 300, 200, 150, 100, and 50 ton, Semi-Automatic Molding Presses, All Self-Contained; Logan 5 Ton Twin Ram 7½ HP M.D. Injection Machines: De Mattia, Model B 24 oz.; Impco 22 oz. Model VF 8-22; Reed-Prentice, 10-E-16, 16 oz. machine; Lester 12 oz. with Glengarry Weigh Feed; Impco 8 oz. Vertical Model VF-8, Late Model; Reed-Prentice 8 oz. late; Reed-Prentice 6 oz. late; Watson-Stillman 6 oz.; Reed-Prentice 4 oz.; De Mattia 4 oz.; Watson-Stillman 4 oz.; Hpm 2 oz. Manual Control; Nrk 2 oz. Hand Operated; Watson-Stillman 2 oz.; Van Dorn, Model H-200,1 oz. and 2 oz. Tablet Machines: Defiance Model #45 200 Ton; Stokes S-5, 280-G, R-1, DD-2, DDS-2, RB-2, RD-4, G-4, RDS-3, R. T. & F Colton #5½, #5, #2-RP and #3-RP, KUX 64. Extruders: Practically New 6" Screw 60" Barrel 4 Zone Elec. Heated; Royle 4⅛" Screw 60" Barrel Elec. Htd.; Royle Nos. 1, 2, 3, and 4; Allen-William 8"—All Individual Motor Drive. Mills: Farrel 20"x22"x72" (2), Farrel 18"x50" (4), Farrel 16"x48" (3), Farrel 16"x40". Available as Mill Lines or as Individual Units. Rotary Cutters: Foremost 25 HP M.D. With Blower; Abbe Size "0" 5 HP Motor Drive; Van Dorn 1 HP M.D. Model C-100, Ball & Jewell 1 HP M.D., Stainless Steel; Calenders: Farrel-Birmingham 24"x48"; Herringbone Gears, 50 HP. D.C. Motor Drive; American Tool 9"x48" Rolls Belt Drive. Mixers: Banbury No. 11, Bodies only; Banbury No. 9, Bodies only; Banbury No. 9, 200 HP Motor Drive; Banbury No. 3A, 150 HP M.D. Roller Coater: Union Roller Coater, Model B-30-50 New 1952 up to 50" Material. Roll Engravers: 3R Gorton Roll Engraver. Will take rolls 30" dia. x 12½ ft. long. Miscellaneous: Sturtevant Blenders: 1—#12 20,000 lbs. Capacity, Practically New; 2—#10 13,000 lbs. Capacity, never used; Stokes Vacuum impregnating Equipment; Despatch 3 Drawer and 8 Drawer Preheating Ovens; Megatherm 3 KW Preheating Ovens; Lydon 21 Drawer Preheat Ovens Motor & Blower (5); Royle 36" Capstan Take up; Watson 30" Type D-C Take up; Thermonic Dielectric Generator Model M-285; Vulcanizers, Grinders, Pumps, Valves, Platens, Etc.; Johnson Machinery Company, 683-P Frelinghuysen Avenue, Newark 5, N. J. What have you for sale? BIgelow 8-2500. What are you looking for?

FOR SALE: Moslo 2-oz Automatic Model 74 Injection press. Used one year. Must sell to make room for new equipment. Wire, phone or write for details. May be seen in operation. Olympic Plastics Company, Inc., 3471 So. LaCienega Blvd., Los Angeles 16, California.

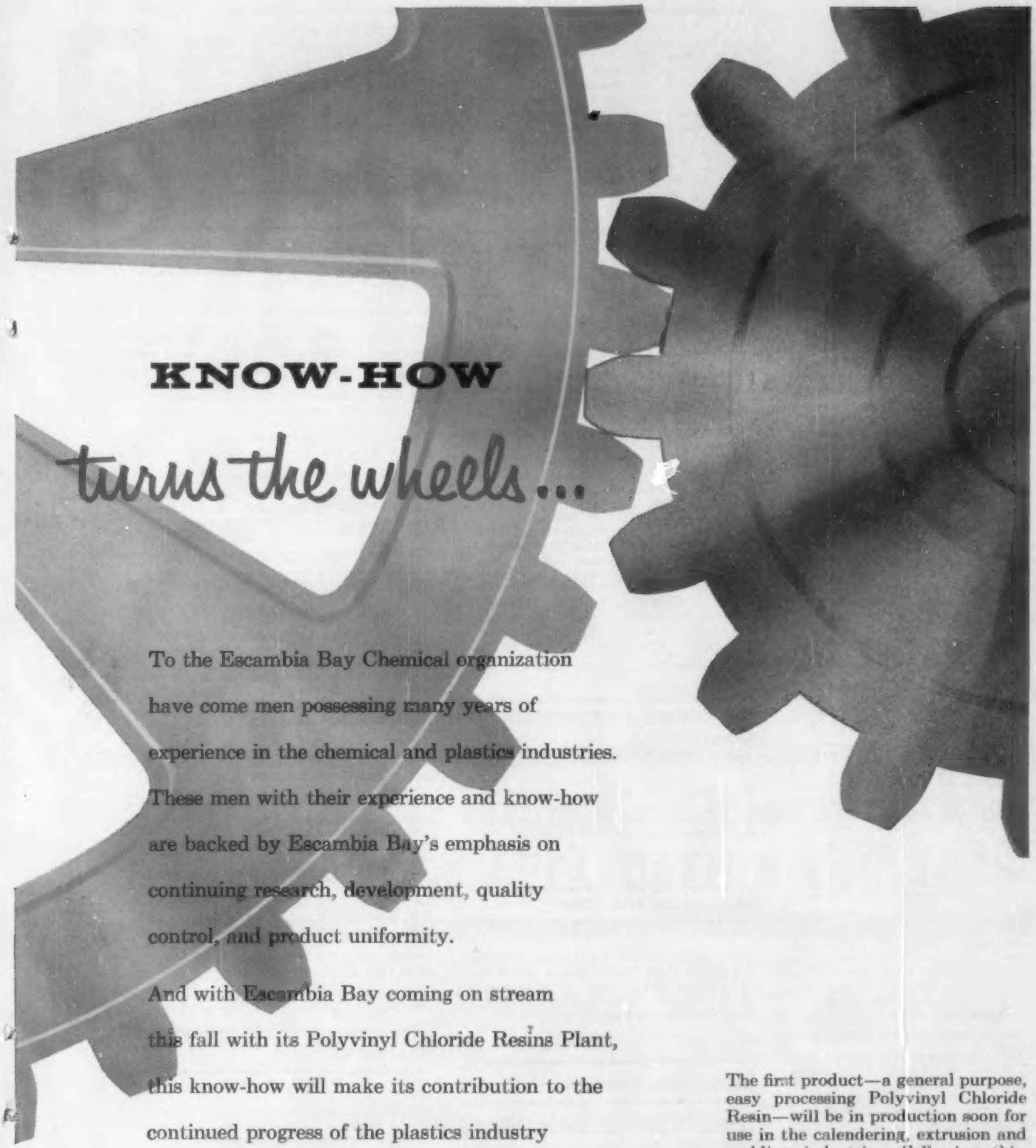
FOR SALE: Lester Injection Molding Machines 4, 8, 12 and 16 oz.—W-S & Baldwin Hobbing Presses 150 to 2000 ton —Bolling Laboratory Presses 50 to 150 ton—Molding Presses & Pumps—new ¾" Hi-Speed Hydraulic 3000 psi Double Solenoid Hydraulic Control Valves—Carver Laboratory Presses, factory reconditioned. New 6"x12" M.P. Laboratory Mills. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N. J. Tel. DE 4-1615; Cable address "Plasmex-Boonton."

FOR SALE: 1—Royle #4 Extruder, motor driven; 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size O m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers; 5—Horizontal Dry Powder ribbon Mixers, 4000#, 1500#, 500#; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Farrel-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines, 2-16 oz.; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425, N.Y Tel.: BArclay 7-0600.

FOR SALE: 3—Ball & Jewell #2, #1½ Rotary Cutters; 1—Cumberland #0 Rotary Cutter; 4—Two Roll Mills 20"x22"x60", 15"x40", 6"x14"; 3—Baker Perkins 100 gal., 50 gal., 2 gal., jacketed double arm Mixers; 1—Stokes Rotary Preform Press #DDS2; 3—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

FOR SALE: Vacum Metallizer Stokes 36". Injection Presses: 8, 12, 24 oz. Reed. 4, 9, 16 oz. HPM. 8, 12 oz. Lester. 4 oz. Lewis. 1 oz. Van Dorn. Extruders: 2½" NRM, 2" steam htd. NRM Saran Pipe setup. Conveyors. Ovens. Compression & Transfer presses: 50 to 600 ton. Elmes Hydrolair 30 T. Automat. Stokes 15 T. Cutler-Hammer 2 KW Electr. Preheaters. Vacuum Form. Mach. Abbott Drape 36x40". Autovac 52x30". Day-Mixer size 0. All Midwest locations. List your Surplus Equipment with me. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

(Continued on page 288)



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FOR SALE: Stainless Steel Rotary Dryer. Link Belt Co., 5'2"x16". No. 502-16, with all aux. equip. Roto louvre also 6'x24' and 5'x26'. Hersey Stainless Steel Rotary Driers. Reply Box 1328. Modern Plastics.

FOR SALE: We have for immediate delivery, due to cancellation, three New Garlock Leather "U" Packings, 33¾"x32" x 13/16" dp. Reply Box 1309, Modern Plastics.

FOR SALE: Hartig 3¼" Plastic Extruder. VanDorn 1 oz. Injection Molding Machine. Stokes R, 2½", single punch, Preform Machine, Kux 2½" dia., single punch Preform Machine. Farrel 15"x36", 2-roll mill. Mills and Calenders up to 84". New Seco 6"x13" and 8"x16" Lab. Mixing Mills and Calenders. Plastic and Rubber Extruders. Oxford 57" Slitter. HPM 1200-ton Laminating Press, 15 openings, 100"x120". Brunswick 225 ton 21"x21" platens. Farrel 200 Ton 30"x30" platens. 200 ton Hobbing Press 18"x14" platens. D&B 140 ton, 36"x36" platens. W-S 150 ton Semi-automatic, 24"x24" platens. D&B 150 tons, 24"x24" platens. Adamson 80 ton, 20"x20" platens. Farrel 200-ton 20"x80" platens. Southwark 30 ton 14"x14" platens, semi-autom. Also Lab. to 2000 tons from 12"x12" to 48"x48". Hydr. Pumps and Accumulators. Stokes Automatic Molding Presses. Rotary and single punch Preform Machines, ½" to 4". Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & J. H. Day Jacketed Mixers. Plastic Grinders. Gas Boilers. Partial Listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn 15, New York. Sterling 8-1944.

FOR SALE: (2) 300 Ton W.S. Presses 20x20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen. Standard Mystic Embossing Presses, Accumulators, Pumps, Valves. 250 Ton W&S 28x24 Platens, 80 Ton Farrel 24x24 Platens. Many other Presses—Send for Bulletin. Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 1—55"x46" hydraulic press, 38" ram; 1—36"x32" hydraulic press, 24" ram; 4—20"x20" presses, 15" rams; 1—R. D. Wood 30 ton 15"x15" self-contained press; 8—Cumberland #1½ granulators, 3, 5 HP; also mills, extruders, mixers, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N. Y.

FOR SALE: Injection Machines. Two "Impco" HA-65—2 to 3 oz. Fully automatic. Stroke adjustable to 15 inches. One of the machines we are offering is the machine that was at the 1954 Cleveland Plastics Exposition. F. J. Kirk Molding Co., Inc., Clinton, Massachusetts.

FOR SALE: (11) 75 ton record presses, complete @ $2,450, (11) new 100 ton, 10" ram, 10" stroke @ $1,100, (8) 200 ton, 9" stroke, 14" ram, 36x36 @ $1,850, (7) 200 ton, 9" stroke, 15" ram, 30x30 @ $1,650, (1) 50 ton complete. 18x18 @ $1,850, (1) 200 ton. 16" ram, 30x30 @ $2,450. (2) 200 ton, 16" ram, 42x42 @ $2,850, (1) 200 ton, 15" ram, 42x42 @ $2,450, (4) 250 ton, (2) 12" rams, 30x60 rebuilt @ $3,375. Hydraulic Sal-Press Co., Inc., 388 Warren Street, B'klyn, N. Y.

FOR SALE: Injection Molding Machines 4 oz. Lesters (2)—Automatic—Good Operating Condition—May be seen in operation—spare parts available—Thomas Manufacturing Corp., 80 Clinton St., Newark 5, N. J. (MItchell 3-1620)

VACUUM FORMER FOR SALE.
Save almost ½ on like-new Abbott two-station 60"x60" vacuum drape forming machine with vacuum pumps, dual timers, automatic oven and controls, dual blowers and duct work. Complete, ready for connection to your power and air supplies. Used only to make samples; never used in production.
Patton Hall, Inc.
2265 W. St. Paul Avenue
Chicago 47, Illinois. Tel: EVerglade 4-4714.

FOR SALE: 4 Stokes "R" Preform Machines, Variable Speed, motor drive; Stokes DD-2 Rotary 21 Station; Day S.S. 350 gal. Double Arm Mixer; Mikro 2 TH Pulverizer; Day 800# S.S. Spiral Mixer. The Machinery & Equipment Corp., 293 Frelinghuysen Ave., Newark, N. J.

NEW ARRIVALS FOR SALE: French Oil Mill Mchy. Compression Molding Presses; 75-170 tons, 3-170 tons, 35"x18", 5-95 tons 29"x18", 3-75 tons 18"x17", 5 Preheaters 2 KW, Wood 20"x20" 12" ram 170 tons; Southwark 24"x24" 12" ram, 170 tons; Baldwin Southwark 4-26"x26" 8" rams, 75 tons; 5-26"x26" 7" rams 57.7 tons; 2-15"x15" 8" rams 75 tons; 2-19"x24" 10" rams, 78 tons; 2-12"x12" 7½" rams 66 tons; 2-D&B 12"x12" 7" rams, 57.7 tons; 8"x9" 4½" rams, 24 tons; D&B 12"x12" 3" rams, 10 tons; HPM Transfer Molding 75 tons; Preform Presses, Colton 5½T Stokes R and DDS-2 MD; New Universal Dual Pumping Units 3-15 HP; Lab. Mills and Calenders; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. Universal Hydraulic Machinery Co. Inc., 285 Hudson St., New York 13.

Machinery and equipment wanted

WANTED: Used Auto-Vac Forming Machine with Drape attachment, size 30"x 50" or 24"x36", 1954 manufacture or later. Reply Box 1335, Modern Plastics.

Materials for sale

FOR SALE: 50,000 gallons of Stripable Sprayable clear Vinyl Plastic Compound in 50 gal. drums price 50¢ per gallon sample on request. Etherton Sales Company, P.O. Box 333, Renton, Washington.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
A. Bamberger Corporation
703 Bedford Ave., Brooklyn 6, N. Y.
MAin 5-7450

WANTED: Plexiglass and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. Duke Plastics Corp., 584 Broadway, B'klyn 6, N. Y. Evergreen 8-5520.

WANTED: Plastic Scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 601 West 26th Street, New York 1, N. Y.

SCRAP WANTED.
Acetate, Butyrate, Polystyrene, Acrylic, any quantity. Also list your surplus inventory of Virgin molding material with us for sale at highest prices.
Claude P. Bamberger, Inc.
1 Mount Vernon St.
Ridgefield Park, N. J.
Tel: HUbbard 9-5330. Not connected with any other firm of similar name.

Molds for sale

FOR SALE: Injection mold, 10 cavities, to mold simultaneously five plastic containers (bottom & lid) in following standard sizes: four containers, square 15/16x15/16 x¾; one container, oblong 31/16x15/16x ¾. Mold will be sold at very reasonable price and is available for immediate possession. Only seriously interested buyer apply to Metropolitan Watch Material Imp. Co., 200 West 72nd Street, New York 23, N. Y.

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 1330, Modern Plastics.

FOR SALE: A number of Compression Type Plastic Molds, to produce Ashtrays, Cigarette Caskets, Household Articles, Lipstick Cases, Flapjacks and Fancy Goods, etc. All Molds in good condition. A once-in-a-lifetime bargain for an estab. manufacturer, or a rare oppty. for someone entering the manufacturing field. Write for complete information. Reply Box 1327, Modern Plastics.

FOR SALE: New 8 cavity mold on unusual double spoon. Item ideal for premium or Chain stores. Also mold for miniature figurenes, hobbs adaptable to other utility items. Write for details. Cloudcrest, Nashville, Indiana.

FOR SALE: Toy Molds. Eight (8) animal head and rattle-teether toy 8 oz. injection molds. Like new. Original Cost $25,000. First $2,500 cash offer takes the lot (bases alone worth that much). Also have molded parts worth $5,000 will sell for $1,000. Need the warehouse space. Reply Box 1317, Modern Plastics.

Molds wanted

WE BUY used molds to use on bakelite stocks press, 150 tons, to produce electric fixtures as fluorescent lampholders, starters sockets, keyless fixtures sockets, wall plates, plug caps, plug bases, etc. Our address is Lux, S. A. Apartado 1510 Monterrey, N. L. Mexico.

Help wanted

WANTED: Semi-experienced and experienced mold designer. Permanent positions for the right men, in the Newark, New Jersey area. Reply stating experience and salary requested to Box 1326, Modern Plastics.

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MARKET RESEARCH.
Senior Man. Newly formed division of major chemical company requires services of man with thermoplastic resin experience. Should have had minimum of 3 years experience in responsible position in market research. Location in greater New York area. Extensive fringe benefits. Excellent opportunity to get in on the ground floor and grow with a new project whose future is literally unlimited.
Send complete resume to:
Box 1306, Modern Plastics.

VINYL CHEMIST.
Experienced in formulation and fabric coating of Plastisols and Organosols. Position in New England area. All replies handled in strictest confidence. Apply Box 1303, Modern Plastics.

REINFORCED PLASTICS ENGINEER: with supervisory ability, must have extensive plant experience in molding and able to completely engineer custom and proprietary jobs from proper mold design, through all tooling to finished parts. Experience should also include design for preform screens, preforming and building phenolic resin molds. Molding experience should cover hand lay-up, resin molds, matched metal molds with preforms and mat. Must also know formulating polyester and epoxy resin. This position offers a tremendous opportunity for the right man to work into the position of assistant manager, with a well established firm now expanding in the plastics field. Location: Midwestern city, slightly over 100,000 population with excellent schools, State University—outstanding recreational facilities. Write complete details to Box 1302, Modern Plastics.

GRADUATE ENGINEER.
Graduate Engineer to work in all phases of injection and compression molding, vacuum forming, finishing and assembly. We will train in all of these areas. Must have supervisory potential.
Reply Box 1308, Modern Plastics.

MOLDING SUPERINTENDENT: Wanted for established custom injection molding plant. Must be experienced with most thermoplastic materials and molding equipment. A valuable opportunity to join an exceptionally modern operation now in the midst of rapid growth. All replies treated confidentially. Reply Box 1300, Modern Plastics.

DEVELOPMENT ENGINEER WANTED: Product designer with some tooling experience wanted by large manufacturer of Juvenile products. Assist head of department in engineering products and expediting tooling. Some experience in injection and vacuum molding desirable. Excellent opportunity for advancement with progressive firm in New York City. Reply Box 1301, Modern Plastics.

TOOL ENGINEER.
To lead up all tooling operations for one of the largest vacuum formers and reinforced pre-mixed molders. Must be capable of engineering, estimating and supervising construction of tools for operations noted above. A tremendous challenge and opportunity in a new plant located in Southwestern Ohio. Prefer graduate engineer, but will consider others with solid background of experience in plastic tooling.
Reply Box 1334, Modern Plastics.

INJECTION MOLDING MACHINERY MANUFACTURED: Has openings for sales engineers and/or manufacturer's representatives and service men in many areas: West Coast, Dallas, St. Louis, St. Paul, Detroit, all the South and many others. Give complete resume of experience and background. Must have experience in plastics field. Write Box 1331, Modern Plastics.

POLYMER RESEARCH.
Monsanto's Texas City Research Department has immediate need of experienced polymer chemists and engineers for evaluation and application research. Assignments in polymer evaluation, design of testing procedures and development of techniques. Primary consideration given to experienced personnel. Openings also for polymerization chemists to work in exploratory and development research in monomers, polymers, copolymers and new techniques of polymerization. Experience preferred, but will consider recent PhD. Salary and position dependent on qualifications, experience and ability. Opportunities to join growing research staff in pleasant Gulf Coast location. Address replies to:
Manager, Technical Recruiting
Plastics Division—Dept. W
Monsanto Chemical Company
P. O. Box 1311
Texas City, Texas

FOREMAN FOR FINISHING DEPT: in Plastic Injection Manufacturing Plant. Must be experienced in spray painting, silk screening, metalizing, inspection, etc. Salary open. State experience, employment history, academic training. Replies held confidential. Plant located in Midwest. Reply Box 1316, Modern Plastics.

EXTRUSION ENGINEER.
Solid propellant rocket development program and industrial projects have opening for well-qualified engineer, B.S. or M.S., mechanical or chemical engineering. Familiar materials and techniques plastics extrusion for pilot plant and semi-production extrusion development work. Challenging position especially interesting to persons with capabilities for professional growth in research and development organization. Send resume experience, education, salary requirements, professional references.
Atlantic Research Corporation
Alexandria, Virginia

EXTRUSION ENGINEER: Midwest-AAA-1. Experienced in die design, extrusion techniques, production and fabrication of custom profiles in rigid and flexible vinyl, nylon, and polyethylene. Please send resume of experience, education, references and salary requirements in first letter. Reply is held confidential. Reply Box 1332, Modern Plastics.

CHEMIST OR CHEMICAL ENGINEER.
We want a man with ideas and a broad general knowledge of plastics who can apply his knowledge to development of home building products. Some paper chemistry or paper converting experience desirable but not essential. In reply, state education, experience and desired salary.
Bird & Son, Inc.
East Walpole, Massachusetts

GENERAL FOREMAN: for Plastic Injection Molding Department. Must be experienced in custom molding. Plant located in midwest. State experience, employment history, academic training, Salary open. Replies held confidential. Reply Box 1315, Modern Plastics.

TECHNICAL SERVICE: Flexibility and ease with people, emotional maturity and a sound chemical background are the things we believe would help you greatly in expanding our technical field service program; we are a midwestern organic-inorganic specialty chemical subsidiary of a Big Board company. We think we work fairly hard and we'd like you to plan an active substantial future with us; some experience in the plastic industry, particularly vinyl, is preferrable but not essential. If you are about 30 years old, do not object to travel, why not drop us a note mentioning your background, your salary suggestions and any points you'd like. Reply Box 1323, Modern Plastics.

WANTED: For polyethylene extrusion of lay-flat tubing and flat film. Chemical or mechanical engineer for complete supervision of large plant. Must have thorough experience and be able to assume complete responsibility. Assured future for the right man. Located New York City. Salary open. Write fully. Reply Box 1307, Modern Plastics.

MOLD ESTIMATOR: Newark, N. J. Mold and die shop desires mold estimator familiar with both compression and injection molds. Must have thorough experience and be able to follow through on quotations. All replies strictly confidential. Only applicants submitting complete resume will be considered. Reply Box 1305, Modern Plastics.

POLYMER RESEARCH.
Group Leader, Polymerization Chemist, Compounder, permanent positions available in expanding polymer research program of national chemical company. Industrial experience in field of fluorine polymers desirable but not essential. Excellent facilities and pleasant working conditions in Suburban Philadelphia Laboratories. Please send resume of personal data, education, experience, and salary requirements to:
Pennsalt Chemicals,
Business Manager, Technical Div.,
P.O. Box 4388, Phila., 18, Pa.
Your correspondence will be held in strict confidence.

PLASTICS ENGINEER: with shop and design experience in low pressure reinforced plastics molding of large shapes. Prefer Chem. Engrng. degree with working knowledge of Mech. Engrng. Outstanding opportunity in young company with great potential. Located San Francisco Bay Region. Forward resume of qualifications, experience to Box 1322, Modern Plastics.

COMMERCIAL DEVELOPMENT DEPARTMENT—PLASTICS
A newly created position with Escambia in its Commercial Development Department requires a man with a broad background of experience in plastics. He will be responsible for the technical and economic evaluations and initial development of markets for new and established monomers and polymers. Applicants for this position should have a degree in Chemistry or Chemical Engineering and 5 to 10 years marketing or development experience in plastics; must be able to assume a major role in guiding company's ventures in plastics field. Location in New York City, traveling required. Please send complete resume of background and experience; state salary required. All replies will be held confidential.
Escambia Bay Chemical Corporation
261 Madison Avenue
New York 16, New York

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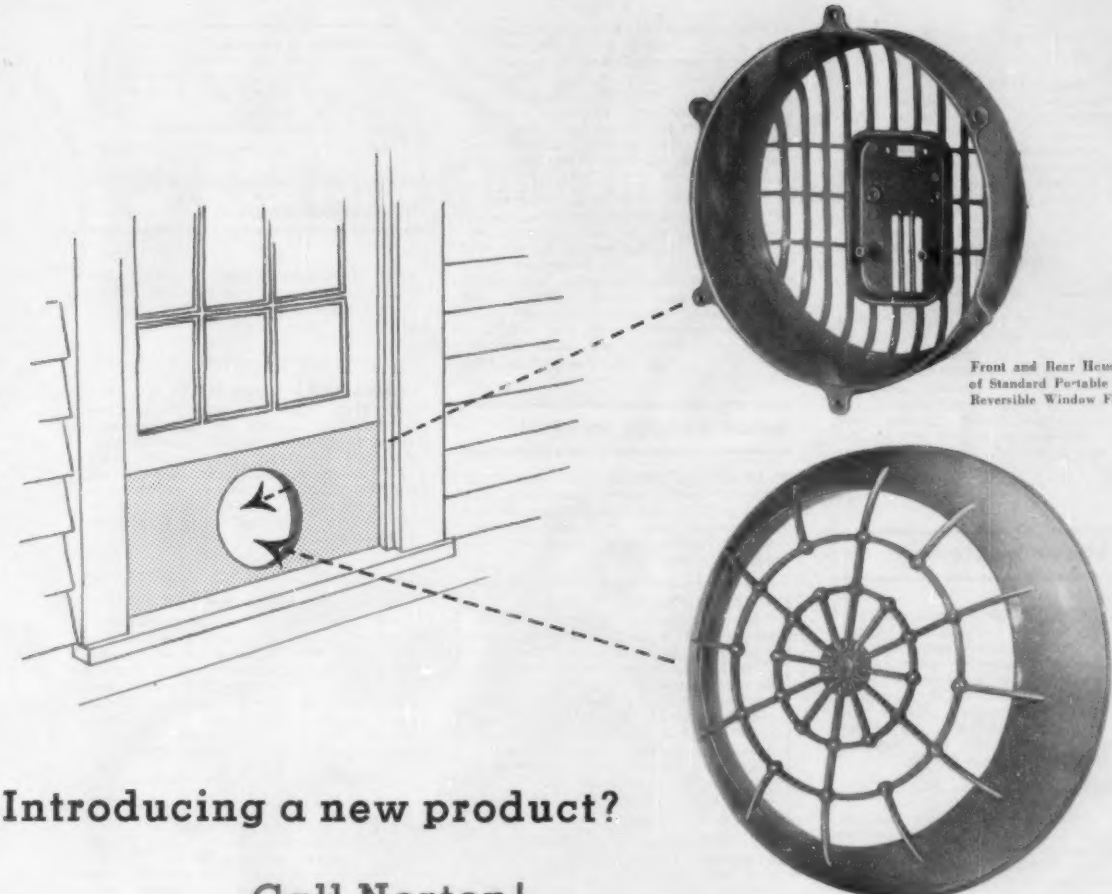

Front and Rear Housings of Standard Portable Cord's Reversible Window Fan

Introducing a new product?

Call Norton!

This window fan housing is a new departure for the Standard Portable Cord Company. Best known for their line of electrical specialties, including a trouble light with permanent magnet for attaching in position, Standard Portable decided to diversify by entering the electric appliance field.

An important factor in the sales appeal of the fan, the housing was designed to give the unit a modern, streamlined appearance. For this all important first product in a new line, Standard Portable placed their trust in Norton Laboratories. The result is shown here—a stylish, handsomely finished plastic casing, injection molded by Norton.

Calling on Norton is common practice among thoughtful companies requiring plastic molded parts for the first time. And this confidence is shared by organizations like Remington Rand, Eastman Kodak, and IBM—all long-time users of plastic moldings. They rely on Norton's more than 25 years' experience with every type of injection and compression molding project.

Companies you can trust . . . trust Norton

Norton Laboratories, Inc., Lockport, New York
Sales Office: New York—175 Fifth Avenue;
(Chicago) Elmhurst, Ill.—203 Elm Square Building; Cleveland—20605 Kings Highway; Detroit—3-167 General Motors Building; Philadelphia—4719 Longshore Street; Rochester—739 Powers Building

NORTON *Laboratories, Inc.*

COMPRESSION AND INJECTION MOLDING

(Continued from page 290)

PLANT SUPERINTENDENT. Flexible Vinyl. Growth creates unusual challenge with Pacific Northwest electronic fabricator—rainwear, industrials, sporting goods, inflatables. Versatility essential—shipping, mechanics, creativeness, purchasing, personnel. Prefer your bettering existing related position. Experience, initiative, ability primary requisites. Require complete resume references, age, education. Replies treated strictest confidence. Reply Box 1320, Modern Plastics.

PLASTICS EXTRUSION OPERATOR & Ass't Extrusion Foreman: Wanted by progressive New York City firm. Pleasant working conditions, chance for advancement unlimited by "seniority" and other restrictions. Excellent opportunity for right man—applications treated with strictest confidence. Write, giving full details to: President, Box 1325, Modern Plastics.

Situations wanted

PLASTICS ENGINEER: 14 years diversified background in compression, transfer and injection molding (8 years in supervisory capacity) covering experimental, developmental and production work. Background includes consulting and mold design. Desire managerial position with plant located in suburban area. Eastern location preferred but not essential. Reply Box 1318, Modern Plastics.

PLANT MANAGER: Desires position with small progressive company specializing in small, close tolerance, thermosetting or thermoplastic molded parts. Capable of handling all phases from product design through production. Reply Box 1319, Modern Plastics.

Plastics Engineer: With experience in injection compression, and transfer molding. Materials, Thermosetting and Thermoplastics, plastic part estimating, product design, new product development, production engineering, sales, technical sales service, mold design, mold procurement, mold estimating, and mold expediting. 15 years of experience in the industry. Reply Box 1313, Modern Plastics.

AN EXECUTIVE POSITION WANTED: Have just resigned a position as president of a corporation. This position was held for 10 years. I have had 21 years experience in the plastics field, particularly the vinyls. I have great imagination and creative ability. Definitely can handle people. Have several outstanding inventions and developments. Reply Box 1312, Modern Plastics.

OVER FIFTEEN YEARS: In research, design, mechanical and business development thermoplastic fabrication including vast background electronic heat-sealing with large company, I am looking for new connection due to circumstances beyond control. Would consider buying interest or partial stock retribution. Top national references on proven business ability. Will meet anywhere at own expense to discuss sound possibility. Reply Box 1310, Modern Plastics.

PH.D.: physical organic chemist, familiar with structures and fabrication techniques of polymers, desires responsible position in Midwest. Reply Box 1324, Modern Plastics.

PLASTICS ENGINEER: Six years experience in sales, technical service, production, and development seeks association with growing organization requiring management personnel and expansion capital. Prefer raw material supplier, molders or extruders, or consulting firm. B.S., Ch.E. and M.B.A. Management. References exchanged. Reply Box 1340, Modern Plastics.

18 YEARS EXPERIENCE: Thermo-setting, compression, transfer molding. Operated own thermo-setting plant over eight years. Thorough grounding planning, mass production, sales, proprietary and custom parts. Know profitable sales management, efficient production planning and operation, costs and estimates, molds, plant set-ups, etc. Hold B.S. degree (Chem. Engr'g.). Reply Box 1341, Modern Plastics.

Sales agents wanted

PLASTIC SALESMAN: for New York, Northern New Jersey, Connecticut and Vicinity. New York City Office provided; good salary plus expenses. Injection molding Plastics bottles. Reply Box 1314, Modern Plastics.

SALES REPRESENTATIVES.
Custom Injection Molding. Experienced, well equipped mid-west plant, 4 to 12 oz., some full automatic. ACTIVE representation wanted to assist further expansion. Unusual facilities for nylon gears and engineered applications all thermoplastics. Modern plant and skilled personnel you'll be proud to represent. Give full resume experience, other lines, references, contacts.
Reply Box 1338, Modern Plastics.

NEW MODERN EXTRUSION PLANT: specializing in the manufacture of precision extruded plastics is seeking experienced manufacturer's representatives to contact unlimited market. All territories open. Write qualifications. Box 1311, Modern Plastics.

WANTED.
Extruded Plastics Salesmen Wanted by Long Established Manufacturer. Excellent opportunity for salesmen to sell Polyethylene and Vinyl Extrusions. Newly developed extrusions and special facilities meet all industrial needs. Some choice territories still available. In stock service, custom work, fast deliveries. Attractive remuneration arrangement. We are interested only in people who have established contacts for extrusions.
Reply Box 1337, Modern Plastics.

POLYETHYLENE BOTTLES: Progressive company, excellent reputation allied field, entering bottle market, seeks experienced salesman. Opportunity for right man who has thorough knowledge bottle market. Reply, in confidence, describing qualifications. We need a man who has contacts for special mold bottles and can help set up sales program. Reply Box 1339, Modern Plastics.

EXPORTER WANTED.
Leading Fiber Glass Weaver seeks topnotch export house to handle foreign sales of woven glass roving for reinforcing plastics.
Reply Box 1304, Modern Plastics.

Miscellaneous

TOY MANUFACTURER: Looking For Original Ideas and Toy Novelties. Hard or Soft Plastics. Reply Box 1336, Modern Plastics.

COPPER-CLAD PHENOLIC: or other metal-clad plastic laminate—patented process for license or sale—material suited for printed circuits, counter tops. Produces material of higher bond strength, at less cost than conventional method of adhering copper foil to laminate base. Glad to send patent copy to interested parties. Rpely Box 1333, Modern Plastics.

PARTNERSHIP WANTED:
I will invest capital as active full-time working partner in operating Plastic Extrusion business. Possess full knowledge and have 10 years experience in straight delivery and cross head extrusions, tool room, dies, set up and operation of machinery, purchasing, sales, management. Metropolitan area preferred. Reply in confidence, Box 1329, Modern Plastics.

WANTED: Injection molds—one item or complete line of proprietary consumer articles, also interested in molds for industrial parts such as knobs, handles, fasteners, boxes, etc. Will consider purchasing complete injection plant with end products or parts line. Designers: New items wanted—cash or royalty. Victory Mfg. Company, 1722 West Arcade Place, Chicago 12, Ill.—Estab. 1930.

INVESTMENT: Product development specialist in plastics desires to purchase interest, as a silent partner, in medium size plant, preferably extrusion or vacuum forming. Reply Box 1321, Modern Plastics.

WANTED—BUSINESS TO PURCHASE: We are authorized representatives for a large group of plastic fabricators who are planning an extensive expansion program for the immediate future. We are interested in purchasing active businesses, primarily engaged in forming and fabricating of thermoplastic sheeting: Plexiglas, Boltaron and Royalite. Please give details indicating facilities available and plant location. All correspondence will be handled in a confidential manner.
Eastern Sales Associates, P. O. Box 158, Centuck Station, Yonkers, New York

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Up to 60 words $10.00	Up to 120 words $20.00	Up to 180 words $30.00
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For further information address Classified Advertising Department, Modern Plastics, 575 Madison Avenue, N. Y. 22, N. Y.

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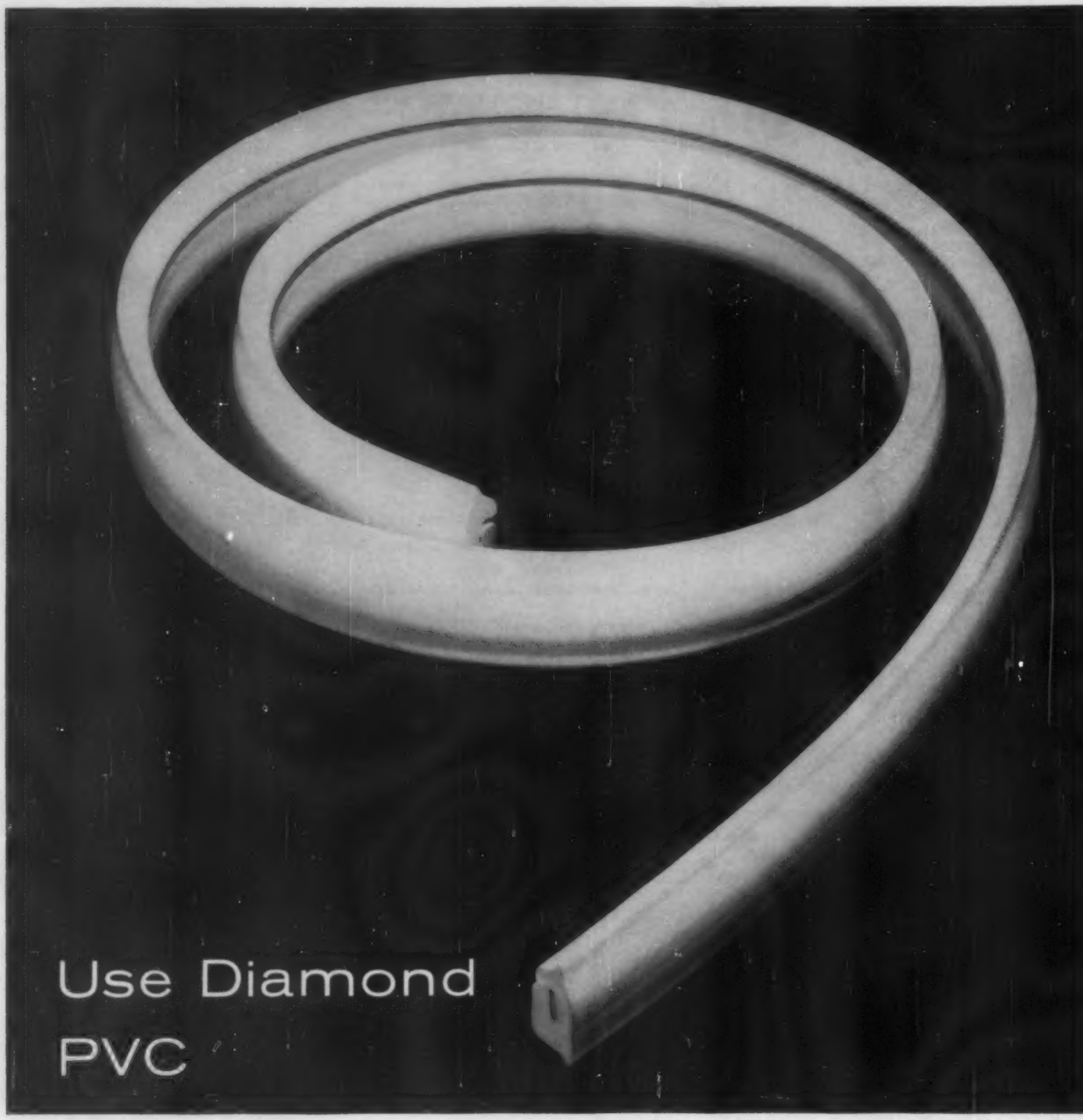

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